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ABSTRACT

This laboratory manual for junior high school students encompasses concepts found in manufacturing. Developed under a contract from the U.S. Office of Education, it is the second part of a 2-year integrated program, and together with the first course in construction technology, provides an introductory study of industrial technology. This manual is designed for use with a textbook (VT 014 240) and teacher's guide (VT 014 238) to provide a complete 1-year course. Each of the 91 activities includes a stated objective and procedures for carrying out the activity with drawings, charts, and pictures provided where necessary. Sample topics include: (1) Manufacturing and the Economic System, (2) Building the Production Prototype, (3) Organization, Ownership, and Profit, (4) Manufacturing Production Technology, (5) Combining Subassemblies, (6) Designing an Engineering the Product, (7) Arranging for Distribution and Sales. Related documents are available as VT 014 088 and VT 014 241-VT 014 244. (GEB)

Industrial Arts Curriculum Project

THE WORLD OF
Manufacturing

LABORATORY MANUAL

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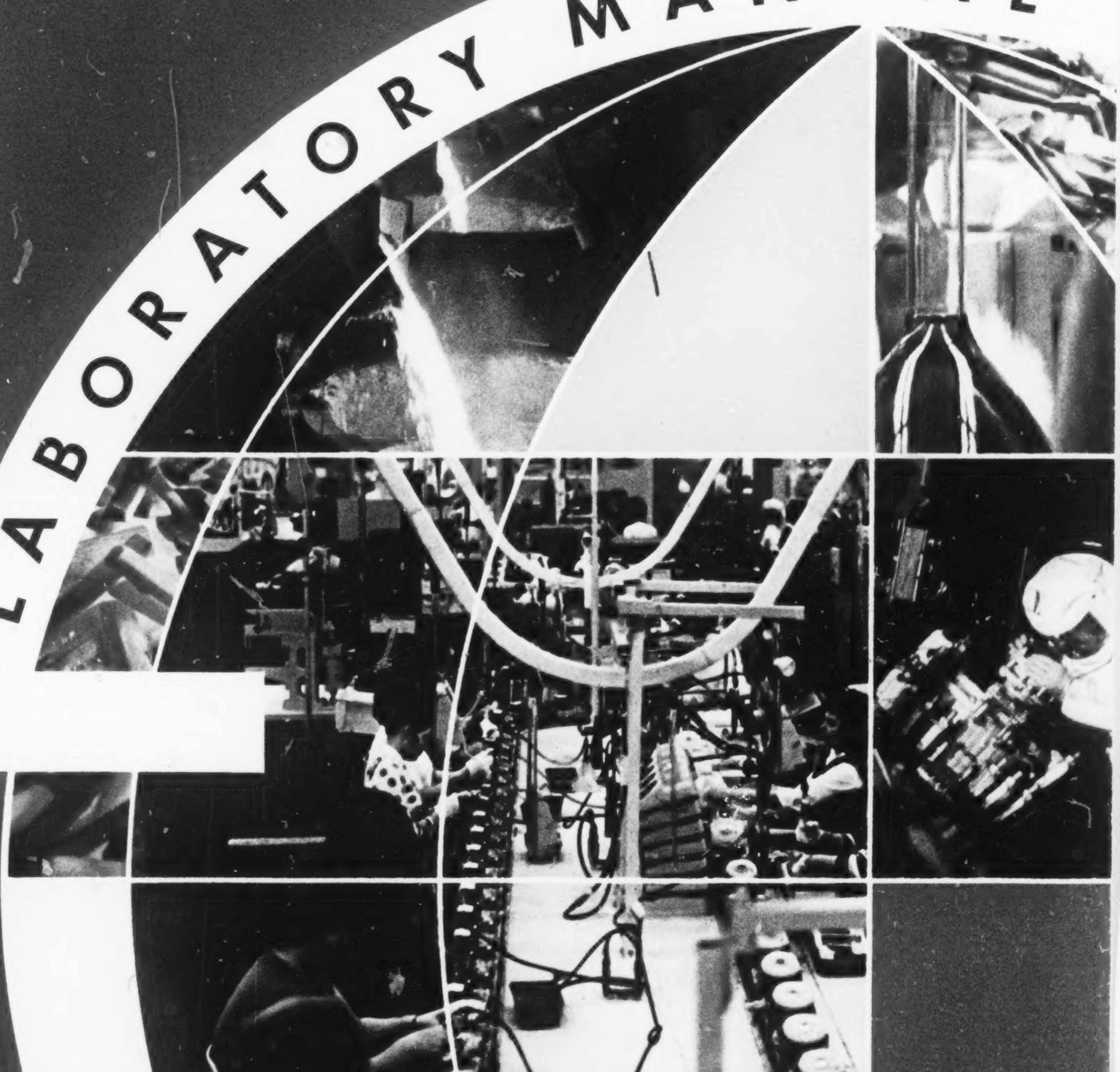

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THE WORLD OF
Manufacturing

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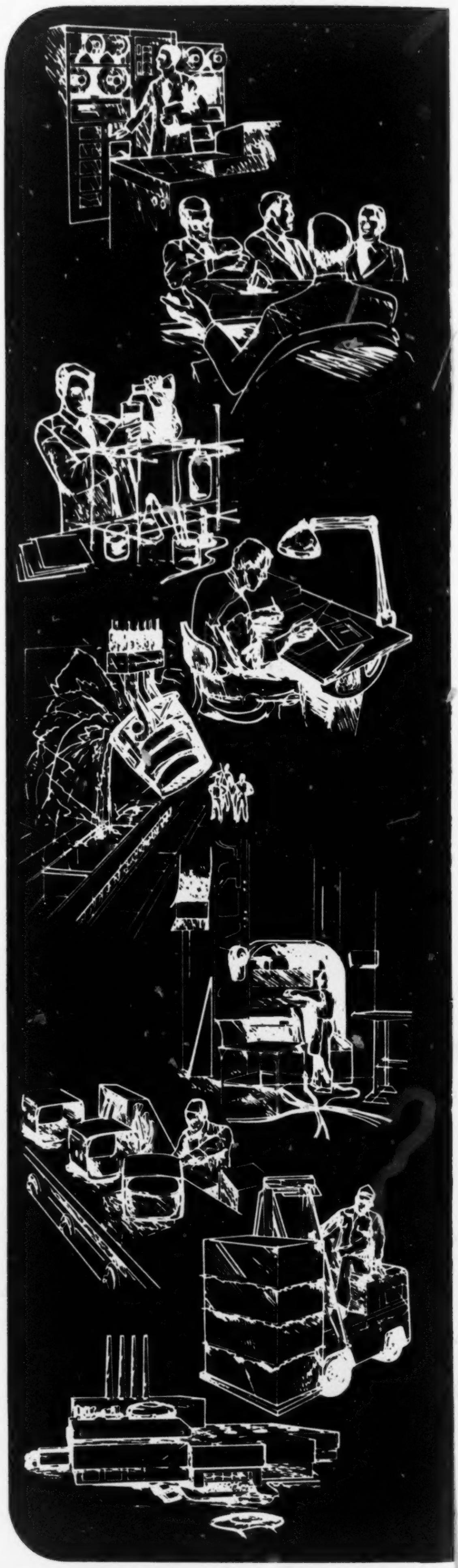

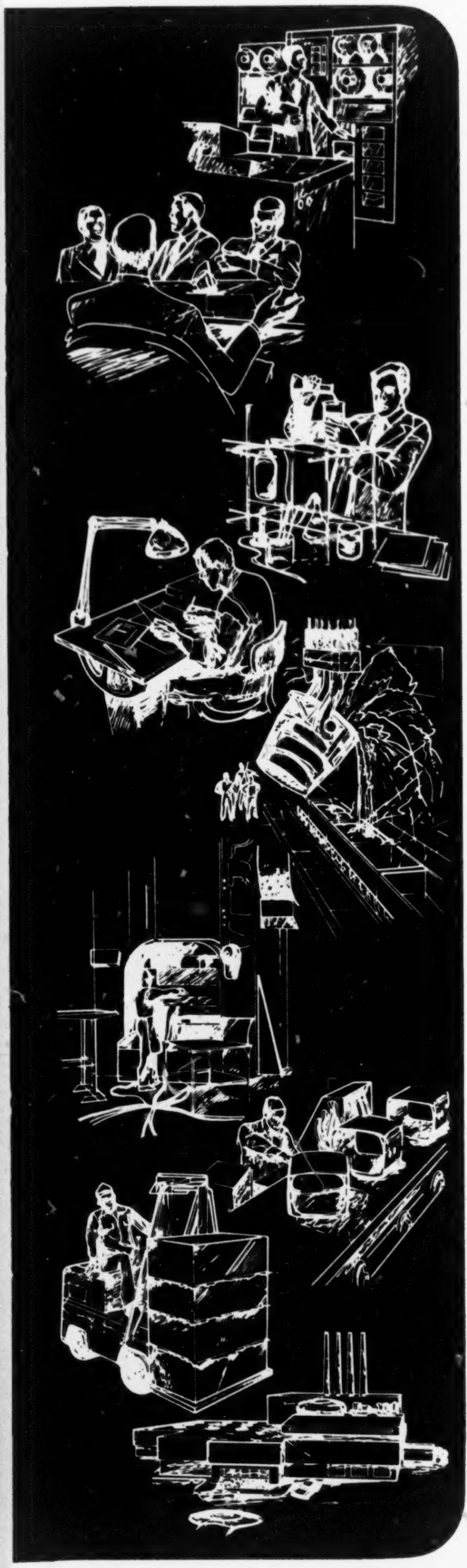

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The title for each Activity is the same as the related Reading in the textbook. Textbook Readings are in the correct sequence for the best explanation of the manufacturing process. However, the students in the test programs gained a better understanding of manufacturing by following the above sequence of Activities. For this reason the Activities are not in the same sequence as the textbook.

ACTIVITY 1

Man and Technology

Problem

Objective

Given a pound of clay, each student should imitate the technology of primitive man by handforming a simple container for water.

Equipment (Group of 5)
1 container for water
1 plastic cup
1 sponge

Equipment (Class)
1 10 gal. plastic bucket with cover for clay storage

Supplies (Each student)
1 pc. 12″ x 24″ (approx.) builder's plastic sheeting
1 lb. red potter's clay

Supplies (Group of 5)
1 pkg. paper towels

Preparing to Work

1. Assemble in groups of five at your work stations. The equipment supervisor will obtain the supplies for your group.
2. Cover your work area with a protective plastic sheeting.

Safety Precautions

a. Keep the work area clean.
b. Never throw clay or any other material around the laboratory.

Forming the Product

3. Shape the clay into any shape container that will hold about 1 cup of water. See Figs. 1-1 to 1-8.

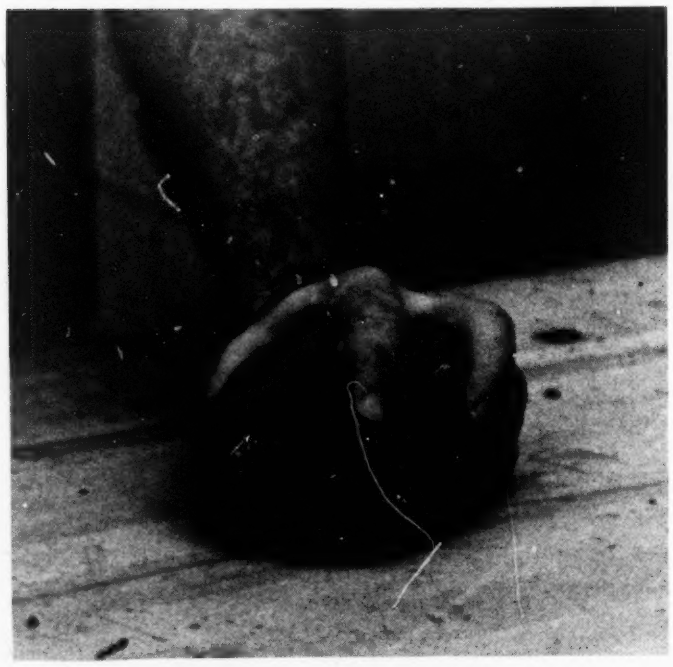


Fig. 1-1. Wedging Clay

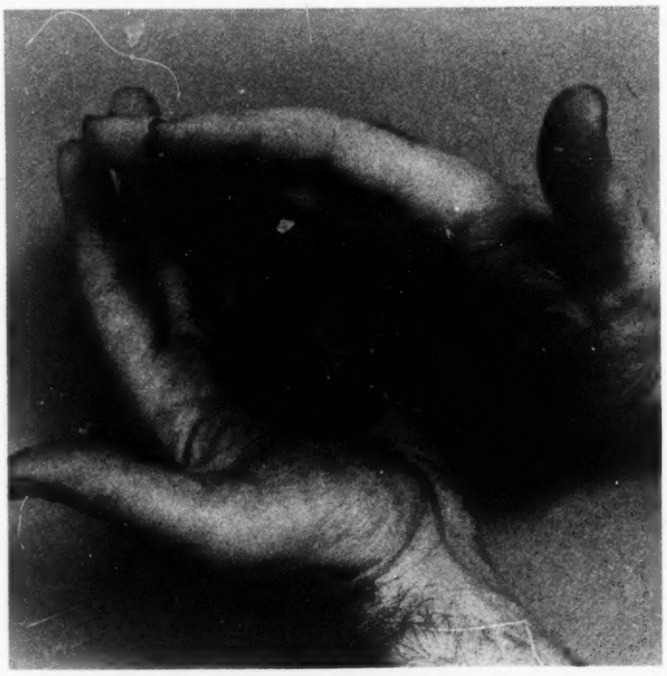


Fig. 1-2. Balling Clay for Pinch Pot

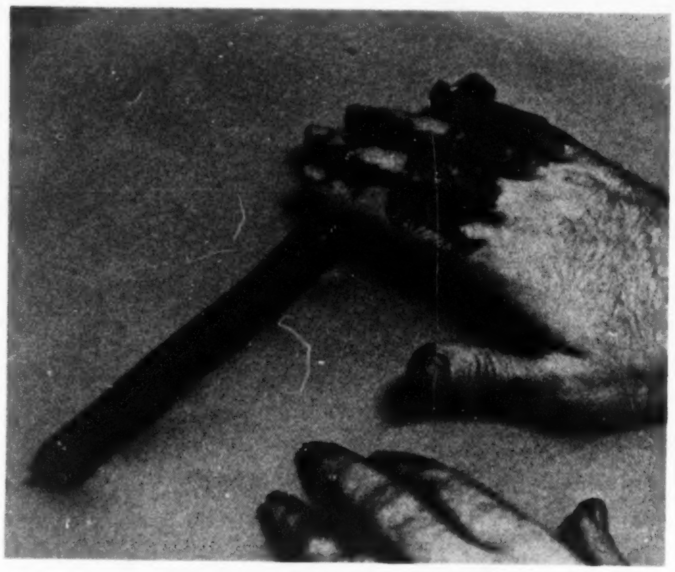


Fig. 1-3. Rolling Clay for Coiled Pot

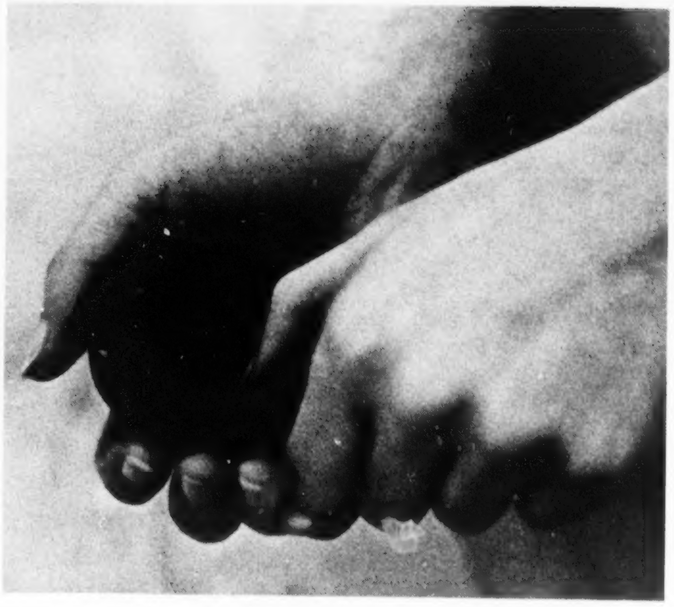


Fig. 1-5. Forming Pinch Pot

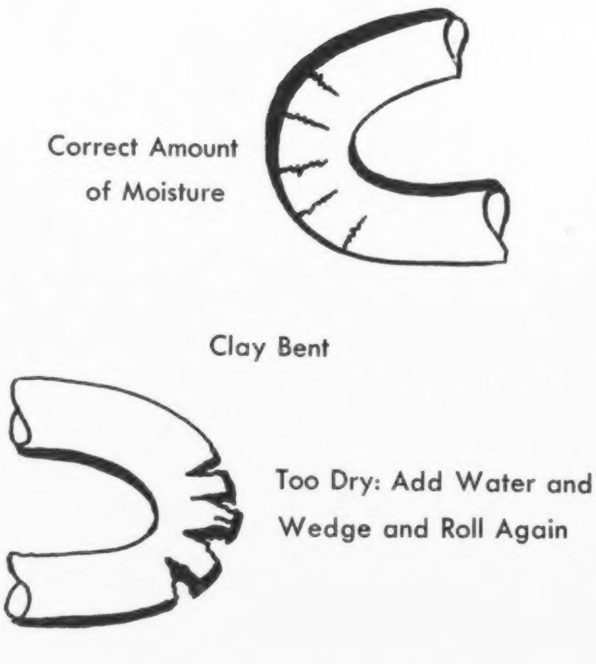

Correct Amount
of Moisture
Clay Bent
Too Dry: Add Water and
Wedge and Roll Again

Fig. 1-4. Testing for Moisture in Clay

Fig. 1-6. Coiling Pot

Fig. 1-7. Assembling Coils

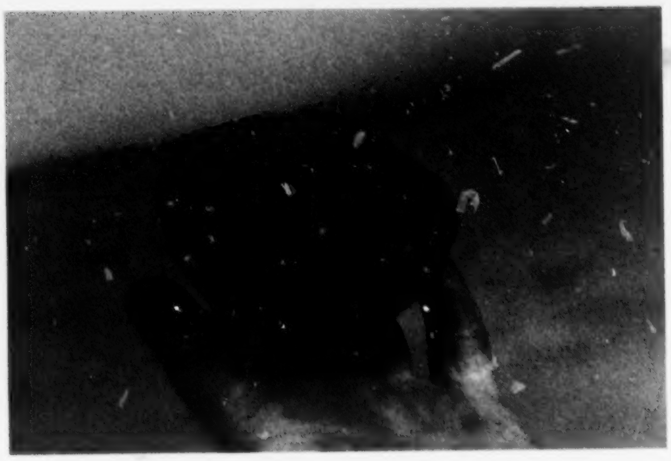


Fig. 1-8. Clay Pot

Cleaning Up

4. Clean the work area and store the clay according to the teacher's directions.

ACTIVITY 2

The Evolution of Manufacturing

Today you will learn how early manufacturers organized people to produce products.

Problem

Objective

Using clay and your personal inventiveness, imitate an early type of manufacture by:

a. Choosing a clay product to produce.
b. Choosing a production process.
c. Organizing so that each worker has a specialized production task.
d. Manufacturing the product.

Equipment (Group of 5)

1	container for water
1	rolling pin
1	sponge
1	bench knife
1	modeling tool
5	tongue depressors

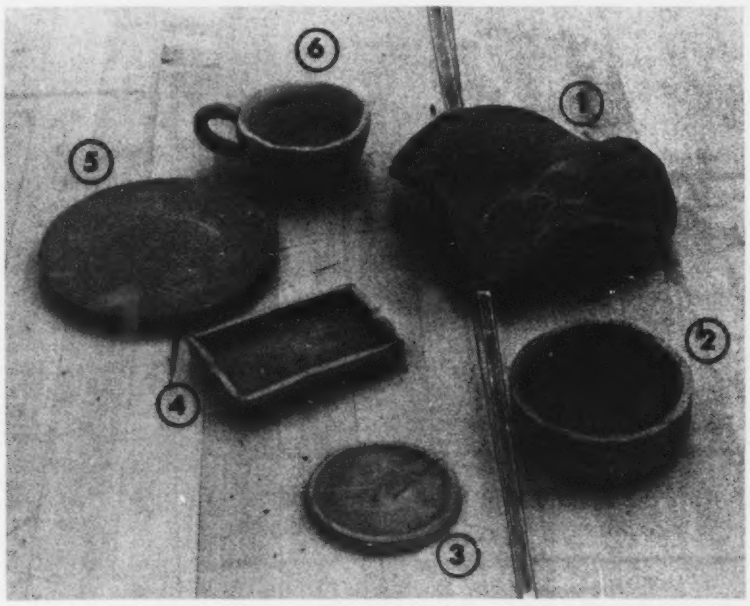


Fig. 2-1. Clay Products

Equipment (Class)

1	10 gal. plastic bucket with cover for clay storage

Supplies (Group of 5)

5 lb.	red potter's clay
1	plastic dropcloth for covering entire benchtop
	rags or paper towels

Selecting a Product

1. Meet with your group in your work area. Get the equipment and supplies.
2. As a group decide which product shown in Fig. 2-1 will be manufactured.

Selecting Manufacturing Process

3. Choose either the *slab* or the *coil* process for making your product.
   a. *Slab Process*—Products 1, 2, 3, 4, and 5 in Fig. 2-1 can be made by rolling, cutting, and assembling *slabs* of clay.
   b. *Coil Process*—Products 2 and 6 in Fig. 2-1 can be made by rolling, coiling, and assembling *coils* of clay.

Organizing for Specialized Work

4. The foreman is to organize your group for production.
5. Your foreman is to assign a member of your group to each operation listed below. Study the figures that show the operations.

Both Processes

a. Wedging and balling: Figs. 2-2 and 2-3
b. Rolling and testing: Figs. 2-4 and 2-5

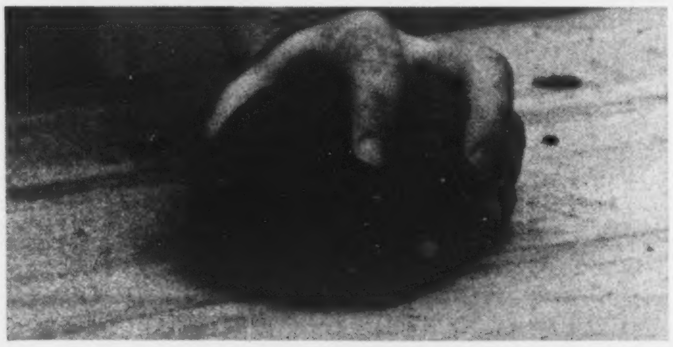


Fig. 2-2. Wedging Clay

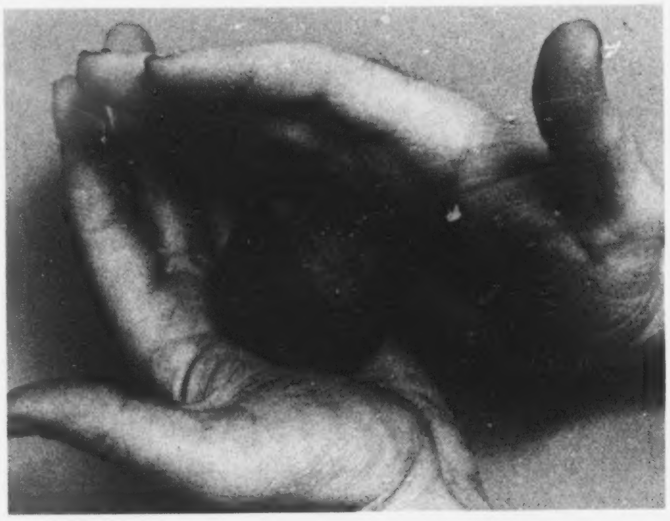


Fig. 2-3. Balling Clay

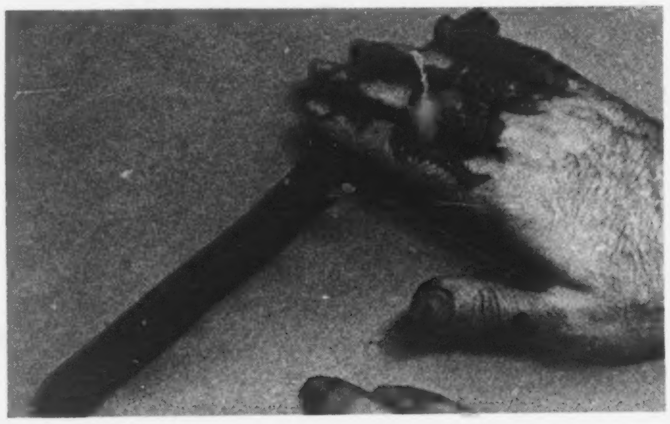


Fig. 2-4. Rolling Clay

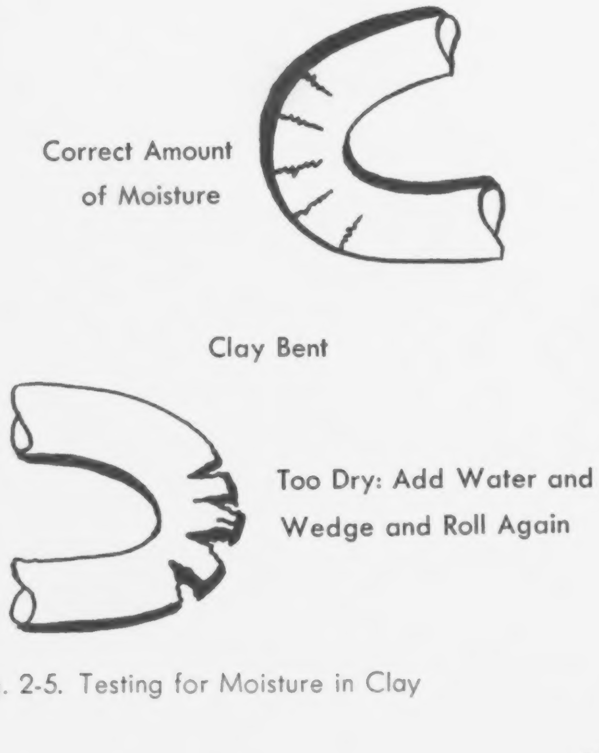

Correct Amount of Moisture
Clay Bent
Too Dry: Add Water and Wedge and Roll Again

Fig. 2-5. Testing for Moisture in Clay

Slab Process

c. Rolling slabs: Fig. 2-6
d. Cutting slabs: Fig. 2-7
e. Assembling slabs: Fig. 2-8

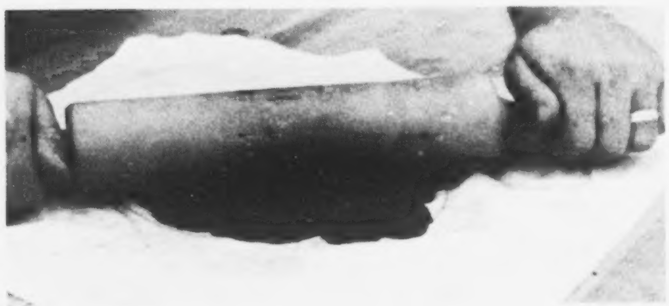


Fig. 2-6. Rolling Slabs

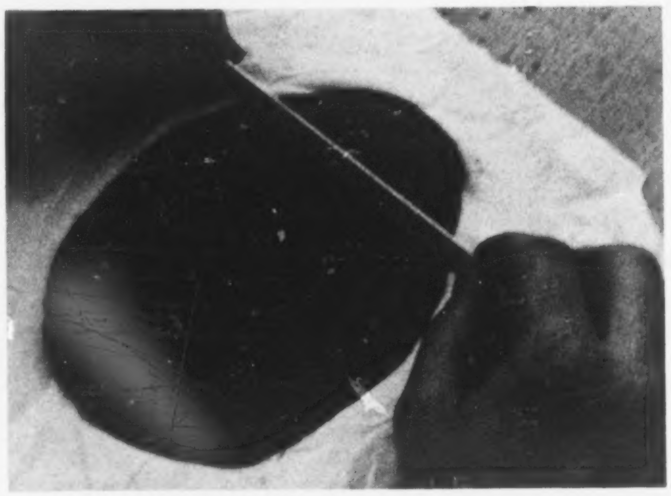


Fig. 2-7. Cutting Slabs

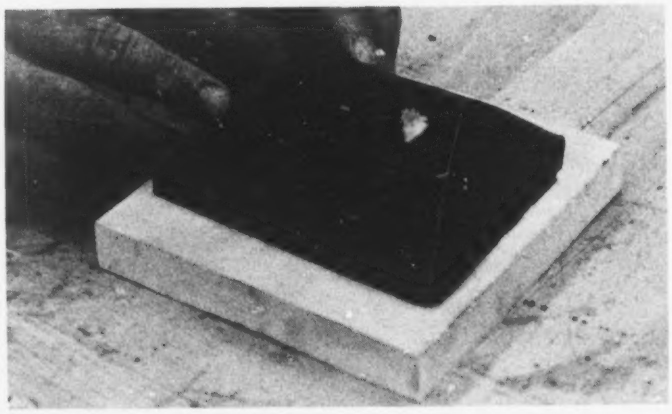


Fig. 2-8. Assembling Slabs

Coil Process

c. Rolling coils: Fig. 2-9
d. Coiling: Figs. 2-10 and 2-11
e. Assembling coils: Figs. 2-12 and 2-13

Manufacturing Products

6. Station yourselves around the workbench and begin. As each task is completed, the materials are to be passed on for the next operation.
7. Manufacture at least five units of your product. Try to keep them about the same size and shape.

Cleaning Up

8. Clean up your work area according to the teacher's directions. Return all equipment and supplies.

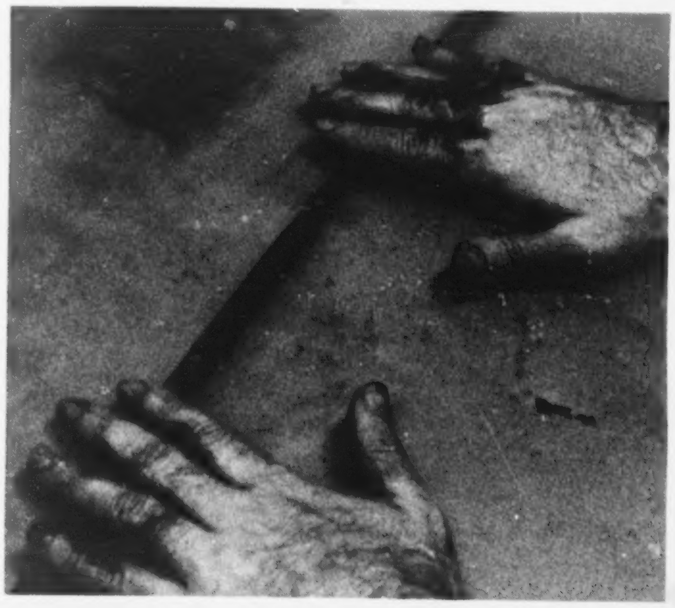


Fig. 2-9. Rolling Coils

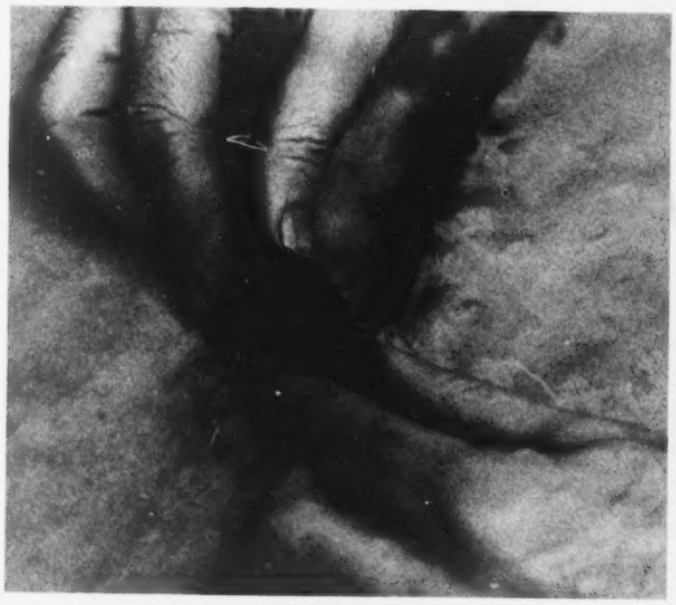


Fig. 2-10. Coiling

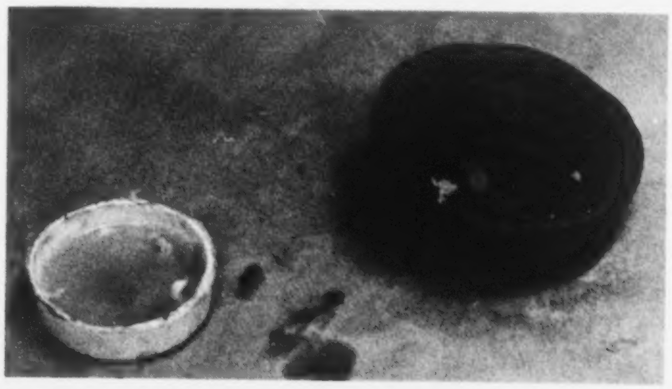


Fig. 2-11. Coiling

Fig. 2-12. Assembling Coils

Fig. 2-13. Clay Product

ACTIVITY 3A

Manufacturing and the Economic System

Today's activity will involve measuring and cutting metal rod to length and bending the wire by hand to form a coat hanger by custom production. You will also get ready to mass-produce the coat hanger.

Problem 1

Objective

Using a length of soft metal rod, manufacture a coat hanger by hand to demonstrate custom production.

Equipment (Group of 5)

2 pr.	combination pliers *or* side cutting pliers
2	bench rules *or* yardsticks
1	sample coat hanger

Supplies (Per student)

1 pc. 1/8" dia. 4' length half-hard aluminum wire (1100 H 19 aluminum) *or* 1/16" soft iron wire

Securing Inputs

1. Assemble with your group. Equipment supervisor get the equipment and supplies.
2. Study the sample coat hanger. The foreman in each group should measure the sample coat hanger to get the basic measurements which everyone in the group will use. See Fig. 3A-1.

Processing

3. Each student is to measure and cut one 4' length of wire from the stock. Make certain that safety rules are followed.
4. Form *by hand* the best coat hanger you can make. See Fig. 3A-2.
5. Save your coat hanger for the next laboratory activity.

Safety

a. Wear safety glasses.
b. Keep wire cutters away from your face when cutting wire.
c. Be careful with the sharp ends of cut wire.
d. Look out for the other fellow's safety and your own when bending wire.

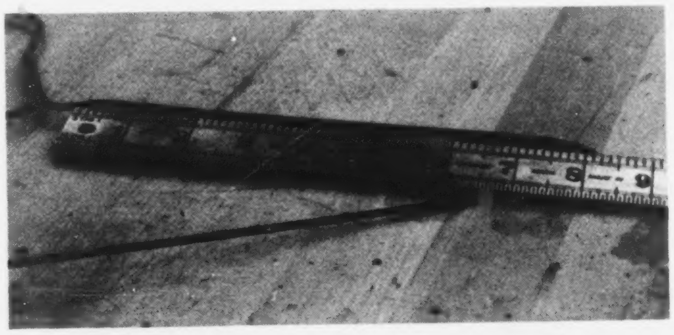


Fig. 3A-1. Measuring

Fig. 3A-2. Forming the Hanger

Cleaning Up

6. Equipment supervisor should return all tools to their proper place and dispose of all scraps.
7. Return to your seat, so that your teacher can demonstrate your next laboratory activity.

Problem 2

Objective

Given the problem of making several coat hangers, organize for mass production.

1. Figure 3A-3 shows the steps you will use to mass-produce coat hangers.
2. Your teacher will assign you to a work station. On the flowchart enter your name under your assigned job.
3. Watch the teacher make a coat hanger, so you will know how.

Fig. 3A-3. Production Flowchart

STATION	OPERATION	STATION	OPERATION
#1.	Measure and shear wire to length. (2 workers) ______ ______	#6.	Back-form hanger. (1 worker) ______
#2.	Measure and mark wire for bends. (1 worker) ______	#7.	File burrs. (5 or 6 workers) ______
#3.	Form hanger bends and twist neck. (6 workers) ______ ______ ______	#8.	Lay out chip board with pattern. (1 worker) ______
#4.	Form and cut neck to length. (1 or 2 workers) ______ ______	#9.	Cut and punch chip board. (2 workers) ______ ______
#5.	Form neck. (1 worker) ______	#10.	Score and fold chip board. (2 workers) ______ ______
		#11.	Assemble chip board to hanger and stack product. (1 worker) ______

ACTIVITY 3B

Manufacturing and the Economic System

Today you will help mass-produce coat hangers and compare them with the hanger you made during ACTIVITY 3A.

Problem

Objective

Given the problem of manufacturing a quantity of coat hangers, perform one specialized task in the production of a coat hanger.

Equipment (Per class with two production lines)

6 pr.	combination pliers *or* side cutting pliers
6	36″ bench rules *or* yardsticks
2	8″ double-cut files
4 pr.	6″ scissors
2	bench knives *or* modeling tools
4	No. 7-1 bending fixtures
4	No. 7-2 twisting fixtures
2 ea.	No. 7-3 and 7-4 bending fixtures
2 pcs.	No. 7-5 hanger neck gage 5½″ x ½″ I.D. pipe
2	No. 7-6 templates for hanger
2	pencils
4	felt markers, red or black

Supplies (Per class with two production lines)

120′	⅛″ dia. half-hard aluminum wire (1100 H 19 aluminum)
3 pcs.	22½″ x 34″ chipboard (.030″ caliper)

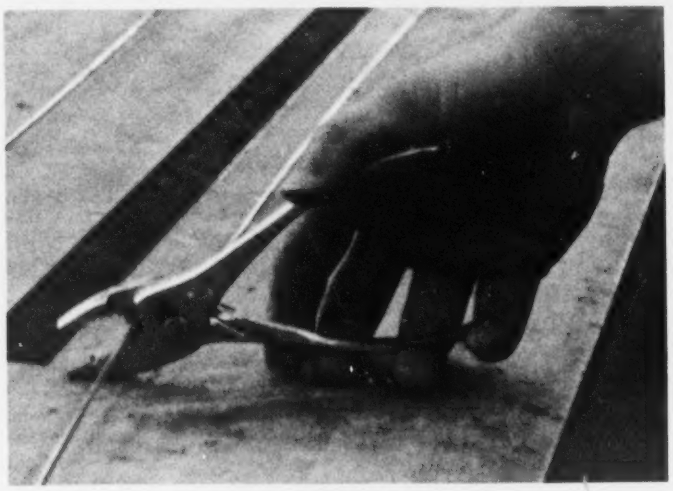


Fig. 3B-1. Cutting Wire to 48″ Length

Working in Production

1. Production lines have been organized for mass-producing coat hangers. You have been assigned a task on a production line.
2. Directions are given for the work to be performed at all stations. *Review* the operation for your work station before you begin.

Station #1—Measuring and Shearing

Needed: Two workers, combination pliers, 36″ bench rule, and marking pen.

Job: First worker measures and marks wire in 48″ lengths. Second worker cuts wire at mark and passes 48″ length to Station #2. See Fig. 3B-1.

Station #2—Measuring and Marking

Needed: One worker, 36″ bench rule, marking pen.

Job: Measure 14″ from end of wire, mark wire at this point, and pass to Station #3. See Fig. 3B-2.

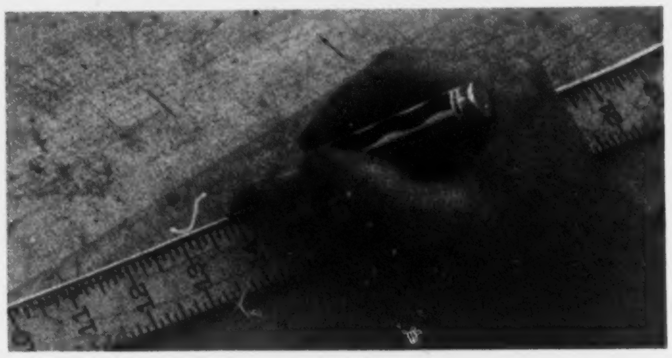


Fig. 3B-2. Measuring 14″

Station #3—Twisting and Bending

Needed: Six workers; two No. 7-1 fixtures; two No. 7-2 fixtures.

Job: First worker should bend wire, using No. 7-1 fixtures. Place wire in fixture so that mark on wire is next to mark on left-hand dowel. See Fig. 3B-3. Bend wire around dowels and guide ends of wire through front of No. 7-1 fixture. See Fig. 3B-4. After bending, pass fixture No. 7-1 with wire to second and third worker. Form the next hanger, using the second No. 7-1 fixture. Workers #2 and #3 should squeeze ends of wire together and place fixture No. 7-2 over the ends of the wire. See Fig. 3B-5. Using fixture No. 7-2 twist wire three turns. See Fig. 3B-6. Remove wrench from wire and take wire out of fixture No. 7-1. Return fixture No. 7-1 to Station 1 and pass wire to Station #4.

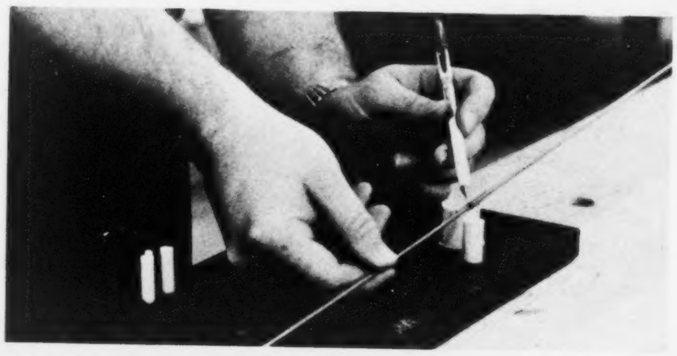


Fig. 3B-3. Positioning 14″ Mark in No. 7-1 Fixture

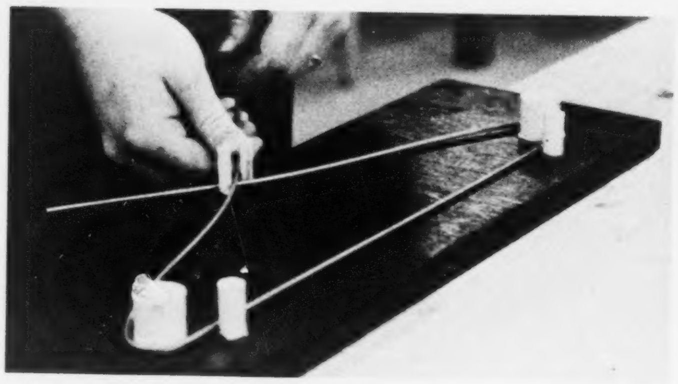


Fig. 3B-4. Bending Wire

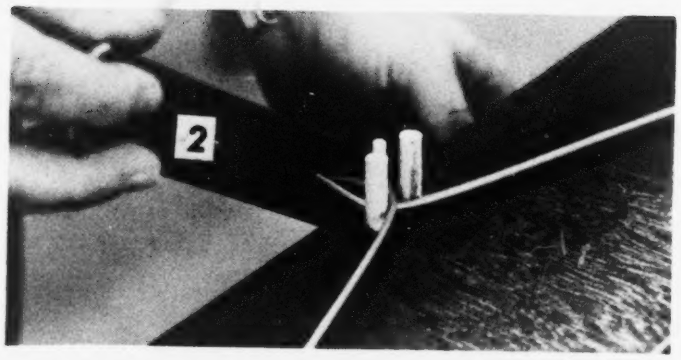


Fig. 3B-5. Inserting Wire in No. 7-2 Twisting Fixture

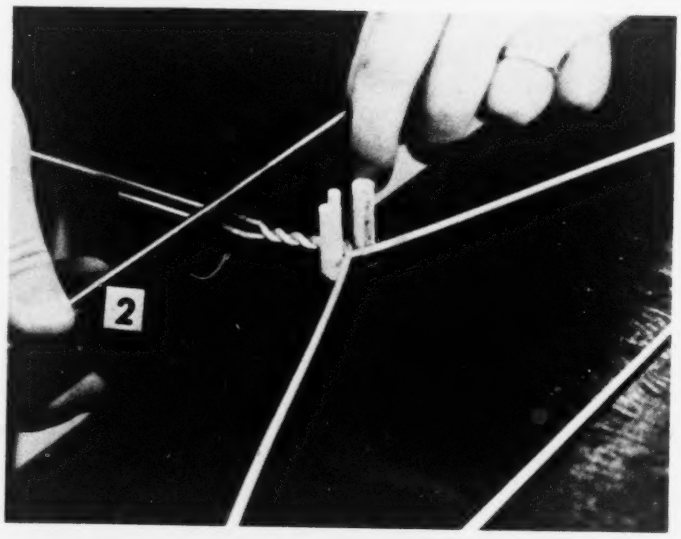


Fig. 3B-6. Twisting Wire

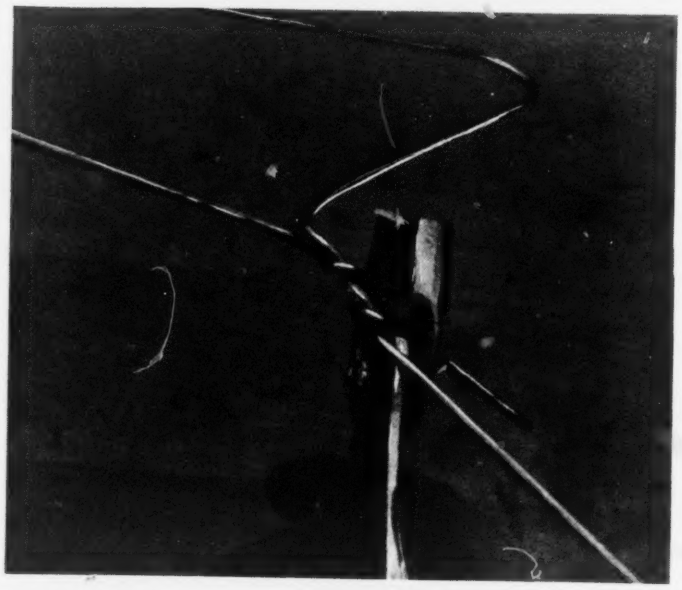


Fig. 3B-7. Cutting Off Short End

Station #4—Forming and Shearing

Needed: One or two workers, No. 7-5 hanger neck gage, and combination pliers.

Job: Form the small twisted end of the wire as shown in Fig. 3B-7. Using No. 7-5 hanger neck gage as a guide, cut neck of hanger as shown in Fig. 3B-8 and pass hanger to Station #5.

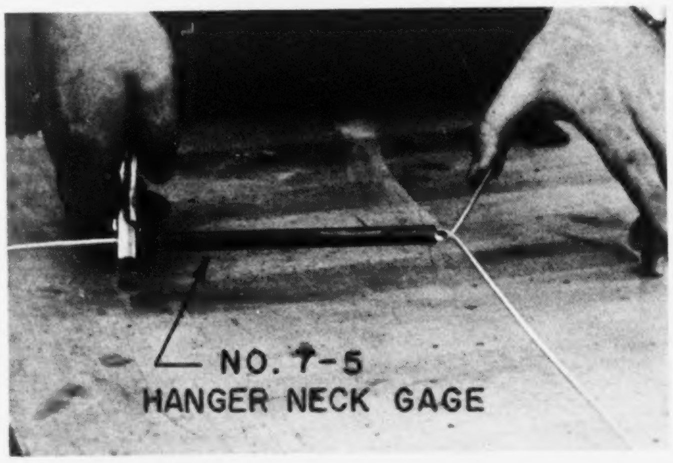
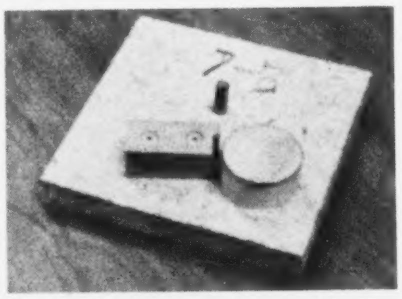


Fig. 3B-8. Cutting Long End to Length Using No. 7-5 Hanger Neck Gage



This is the improved design for making the neck bend. This fixture is available in the official IACP equipment package from McKnight & McKnight Publishing Company.

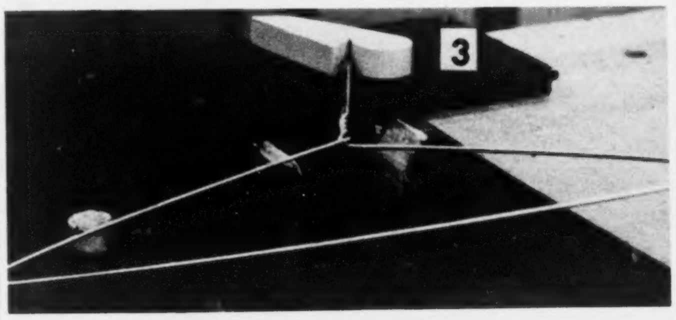


Fig. 3B-9. Position to Start Neck Bend in Fixture No. 7-3.

Station #5—Forming

Needed: One worker, and fixture No. 7-3.

Job: Form the neck of the hanger as shown in Figs. 3B-9 and 3B-10. Pass the hanger to Station #6.

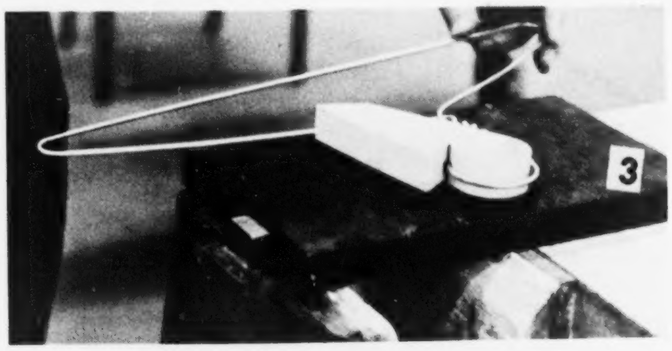
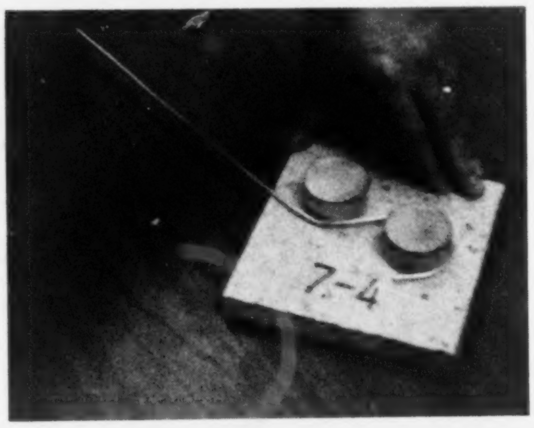


Fig. 3B-10. Completing Neck Bend



This is the improved design for back-forming of the neck. This fixture is available in the official IACP equipment package from McKnight & McKnight Publishing Company.

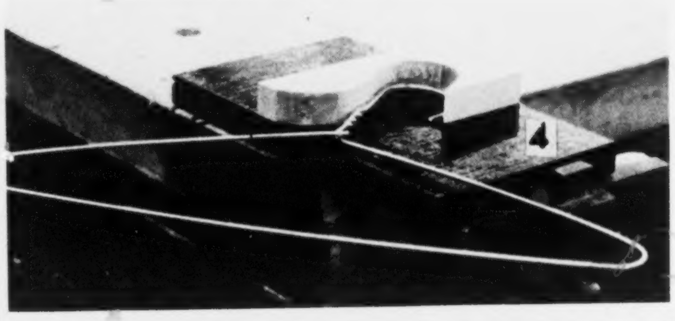


Fig. 3B-11. Position to Start Back-Form of Neck in No. 7-4 Fixture

Station #6—Back-Forming
Needed: One worker, and fixture No. 7-4.
Job: Back-form the neck of the coat hanger as shown in Figs. 3B-11 and 3B-12. Pass hanger to Station #7.

Station #7—Filing
Needed: Five or six workers and files.
Jobs: File burrs from ends of wire as shown in Figs. 3B-13 and 3B-14. Pass hanger to Station #11.

Station #8—Laying Out
Needed: One worker, No. 7-6 pattern, pencil and chipboard.
Job: Mark chipboard, using No. 7-6 pattern provided. See Fig. 3B-15. Pass chipboard to Station #9 to be cut.

Station #9—Separating and Punching
Needed: Two workers, scissors, and paper punch.
Job: Cut and punch the chipboard blanks as shown in Figs. 3B-16 and 3B-17. Pass blanks to Station #10.

Station #10—Scoring and Folding
Needed: Two workers, bench knife or modeling tool, and bench rule.
Job: Score but do *not* cut chipboard. See Fig. 3B-18. Fold along scored line. See Fig. 3B-19. Pass folded chipboard to Station #11.

Station #11—Assembling
Needed: One worker.
Job: Insert folded chipboard on coat hanger as shown in Fig. 3B-20. Stack the product.

Questions

1. Which manufacturing process resulted in products that were more like the model in size and shape? Check one.

____The hand process

____ The mass-production process

2. Which process was more efficient?

____ The hand process

____ The mass-production process

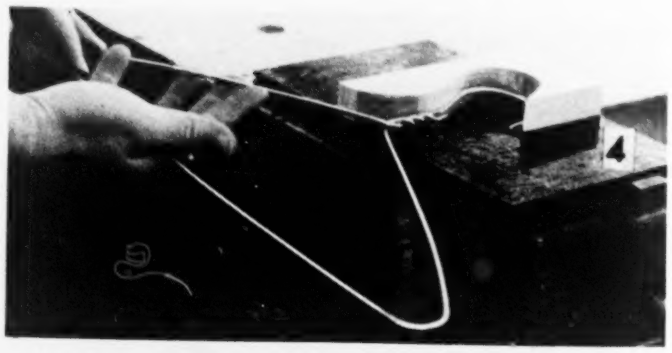


Fig. 3B-12. Completing Back-Form of Neck

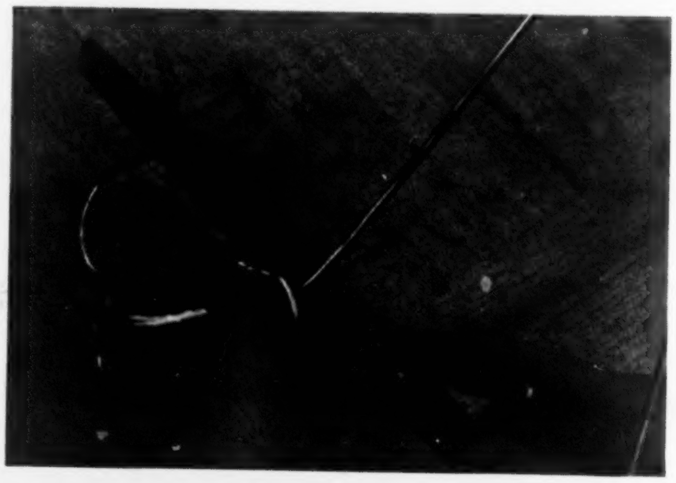


Fig. 3B-13. Filing Off Burrs

Fig. 3B-14. Filing Off Burrs

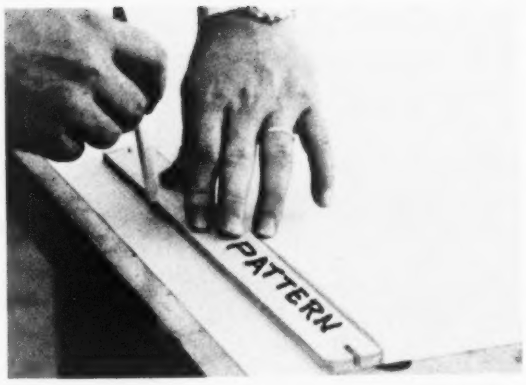


Fig. 3B-15. Tracing Around No. 7-6 Pattern

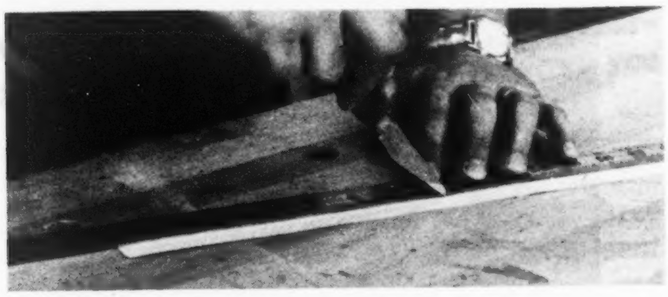


Fig. 3B-18. Scoring the Chipboard

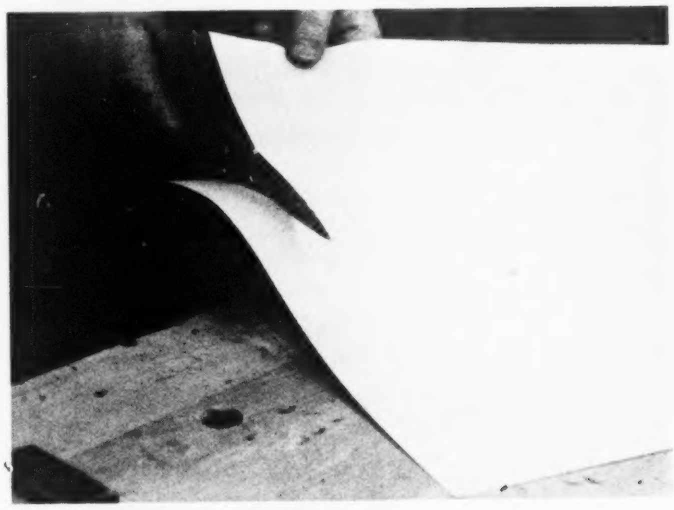


Fig. 3B-16. Cutting Chipboard

Fig. 3B-19. Folding

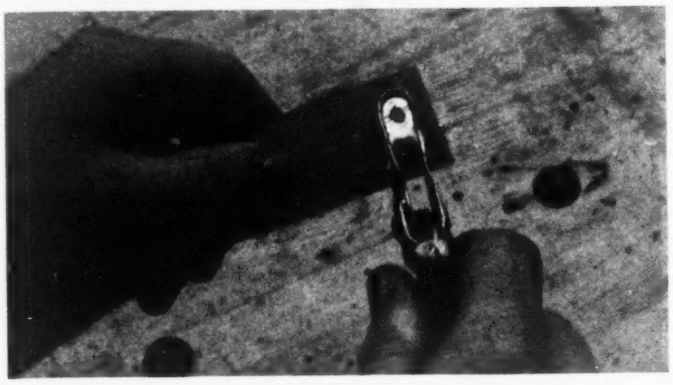


Fig. 3B-17. Punching Chipboard

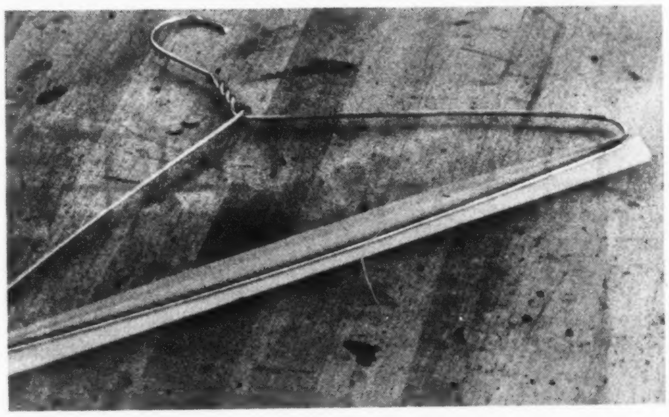


Fig. 3B-20. Chipboard Inserted, Hanger Completed

Cleaning Up

3. Clean up the production line and rearrange tools and supplies at your work station.
4. Complete the questions for this laboratory activity.

ACTIVITY 4A, B

Manufacturing Technology

Today's activities concern rockets. Your group will build four different model rocket airframes. You will also carry out the three basic kinds of research activity: (1) *retrieving* information, (2) *experimenting*, and (3) *describing* what you observe.

Problem 1

Objective

Using a drawing of a model rocket, retrieve information about the basic parts.

Retrieving Information

1. Using Fig. 4A-1, *retrieve information* about the basic parts of a model rocket. Enter the names of the parts in the blanks.

   a. The ______________ is the front part of the rocket.

   b. The ______________ is the basic part of the rocket to which all other parts are attached.

   c. The ______________ guides the model rocket as it leaves the launch pad.

   d. The ______________ guides the rocket after it leaves the launch pad.

   e. The ______________ propels the rocket forward by thrust, as the solid fuel burns.

   f. A ______________ is needed to return the rocket to earth with a soft landing.

   g. The ______________ transmits the engine's thrust to the airframe.

   h. An ______________ is used to ignite the rocket fuel electrically.

   i. Fl__________ wa__________ protects the recovery device from the engine backfire.

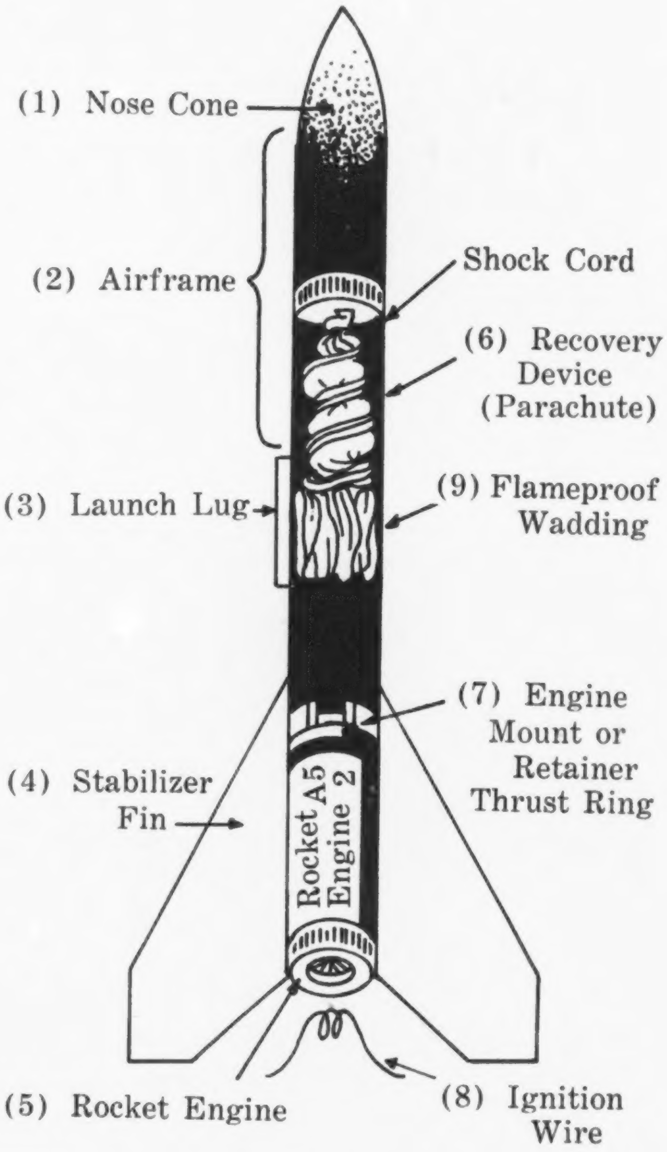

(1) Nose Cone
(2) Airframe
Shock Cord
(6) Recovery Device (Parachute)
(3) Launch Lug
(9) Flameproof Wadding
(7) Engine Mount or Retainer Thrust Ring
(4) Stabilizer Fin
Rocket A5 Engine 2
(5) Rocket Engine
(8) Ignition Wire

Fig. 4A-1. Parts of a Model Rocket

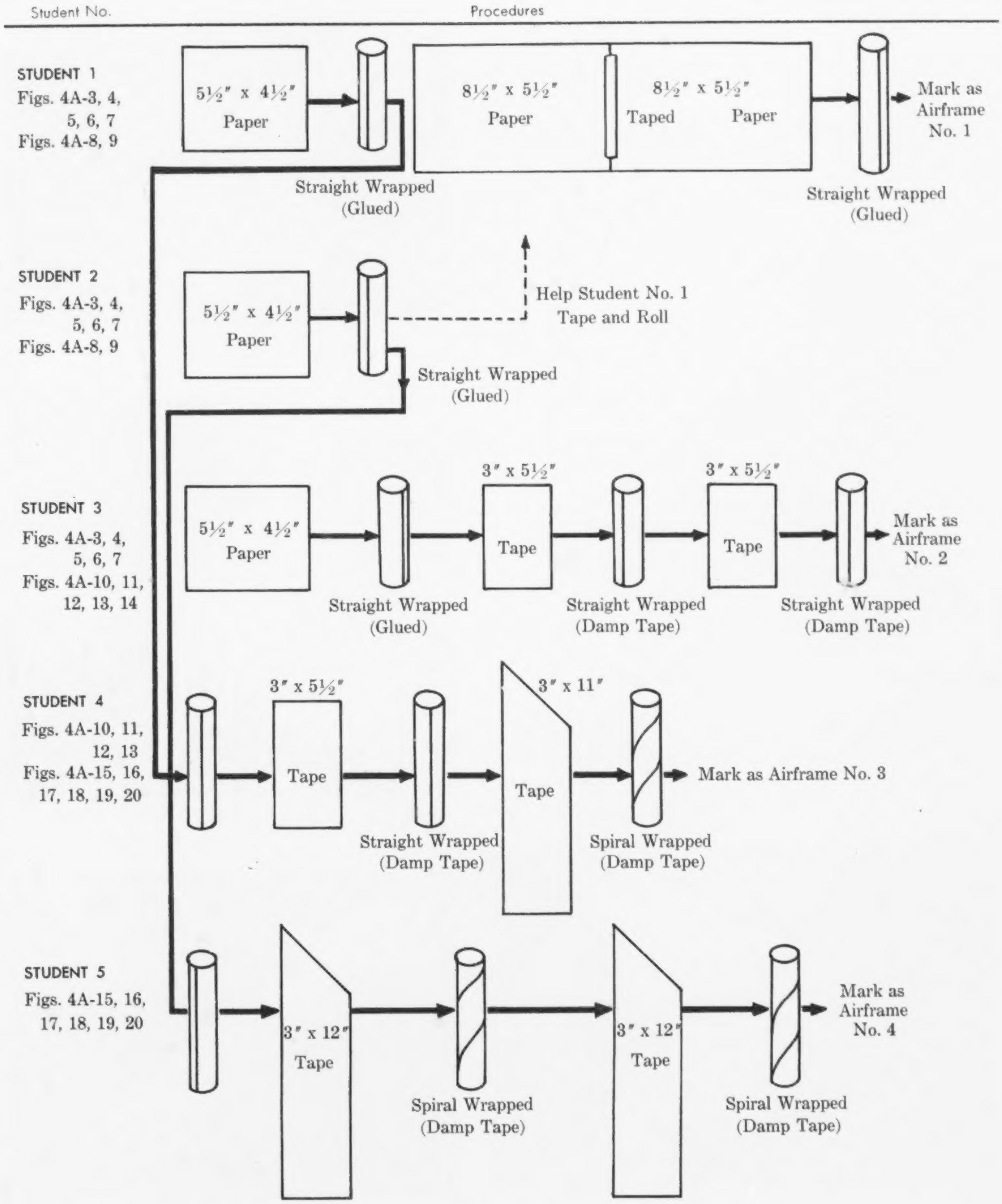

Student No.
Procedures
STUDENT 1
Figs. 4A-3, 4, 5, 6, 7
Figs. 4A-8, 9
5½" x 4½" Paper
Straight Wrapped (Glued)
8½" x 5½" Paper
8½" x 5½" Taped Paper
Straight Wrapped (Glued)
Mark as Airframe No. 1
STUDENT 2
Figs. 4A-3, 4, 5, 6, 7
Figs. 4A-8, 9
5½" x 4½" Paper
Help Student No. 1 Tape and Roll
Straight Wrapped (Glued)
STUDENT 3
Figs. 4A-3, 4, 5, 6, 7
Figs. 4A-10, 11, 12, 13, 14
5½" x 4½" Paper
Straight Wrapped (Glued)
3" x 5½" Tape
Straight Wrapped (Damp Tape)
3" x 5½" Tape
Straight Wrapped (Damp Tape)
Mark as Airframe No. 2
STUDENT 4
Figs. 4A-10, 11, 12, 13
Figs. 4A-15, 16, 17, 18, 19, 20
3" x 5½" Tape
Straight Wrapped (Damp Tape)
3" x 11" Tape
Spiral Wrapped (Damp Tape)
Mark as Airframe No. 3
STUDENT 5
Figs. 4A-15, 16, 17, 18, 19, 20
3" x 12" Tape
Spiral Wrapped (Damp Tape)
3" x 12" Tape
Spiral Wrapped (Damp Tape)
Mark as Airframe No. 4

Fig. 4A-2. Airframe Fabrication Procedures

Problem 2

Objective

Using the needed equipment and supplies, help construct four airframes by different fabrication techniques.

Equipment (Group of 5)
5 pcs. 1″ dia. x 12″ dowel
1 sponge (damp)
2 pr. scissors
1 12″ rule

Supplies (Group of 5)
3 pcs. 4¼″ x 5½″ white bond paper, 20#
2 pcs. 5½″ x 8½″ white bond paper, 20#
1 btl. white glue
4 paper towels (damp)
1 roll 3″ gummed paper tape
1 roll masking or transparent tape

Producing Airframes

1. The foreman should assign each group member a number from 1 to 5 from Fig. 4A-2. Each member should then study the procedures shown under his student number in Fig. 4A-2.
2. Each student should study the figures listed under his Student No. These figures show the fabrication procedures.

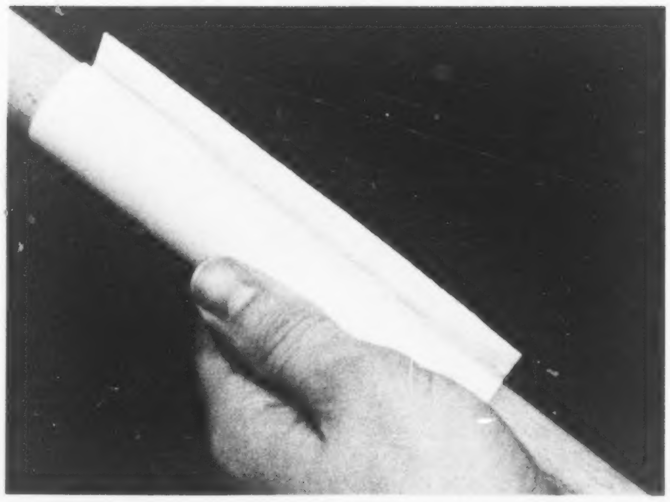


Fig. 4A-4. Rolling the Paper around the Dowel

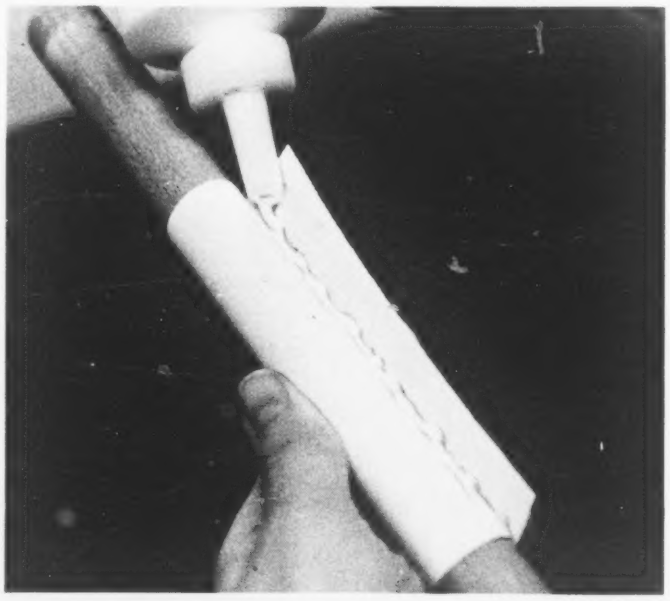


Fig. 4A-5. Applying Glue

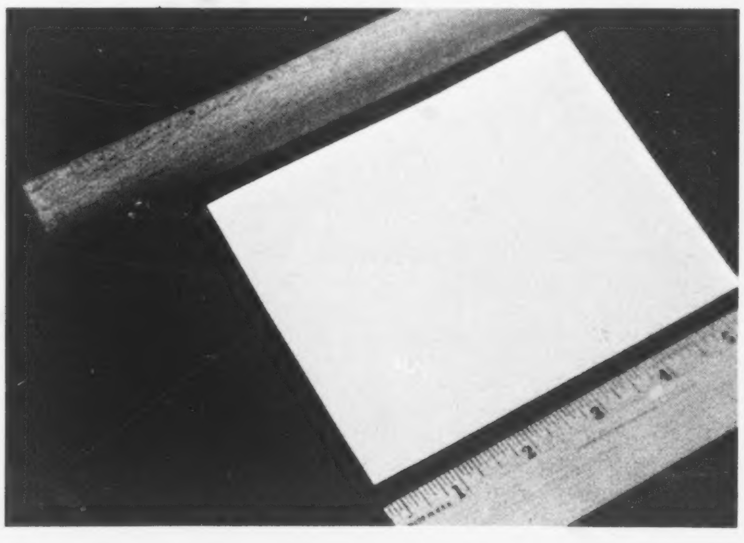


Fig. 4A-3. Positioning the Paper

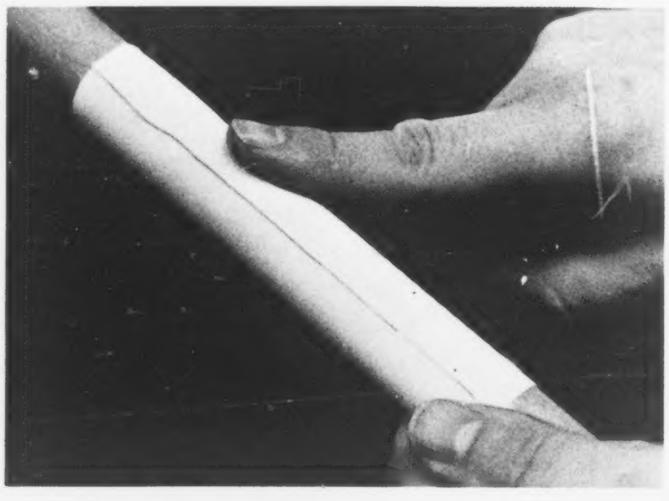


Fig. 4A-6. Pressing the Seam Together

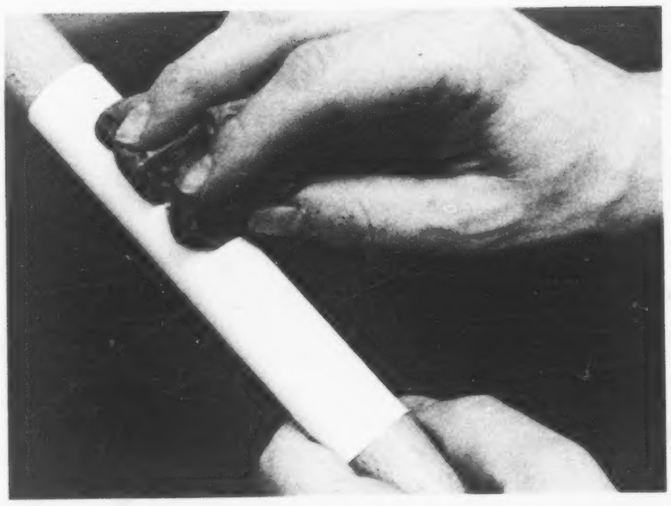


Fig. 4A-7. Removing Excess Glue

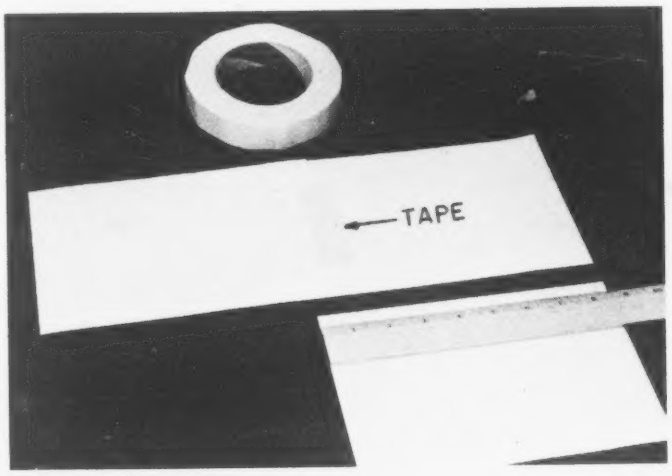


Fig. 4A-8. Taping Paper

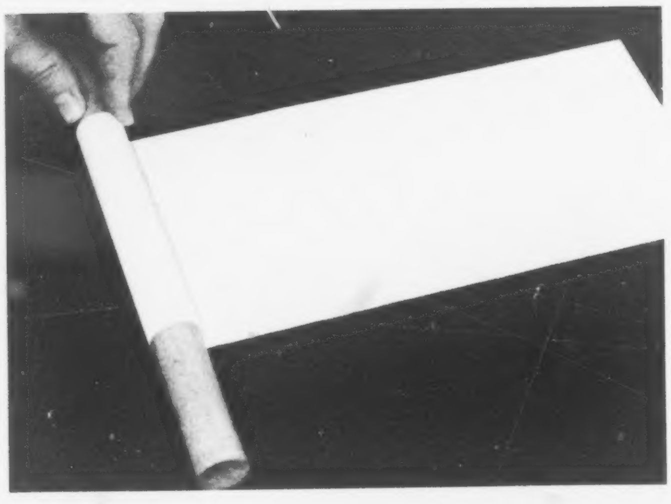


Fig. 4A-9. Rolling the Paper

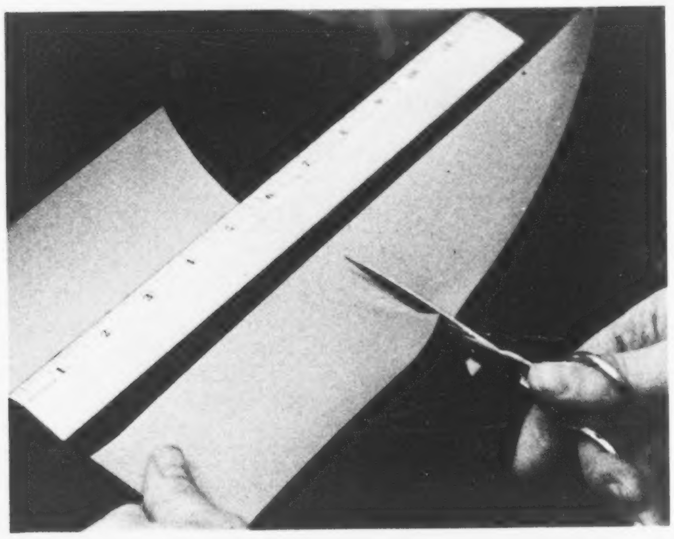


Fig. 4A-10. Cutting 5½″ Paper Tape

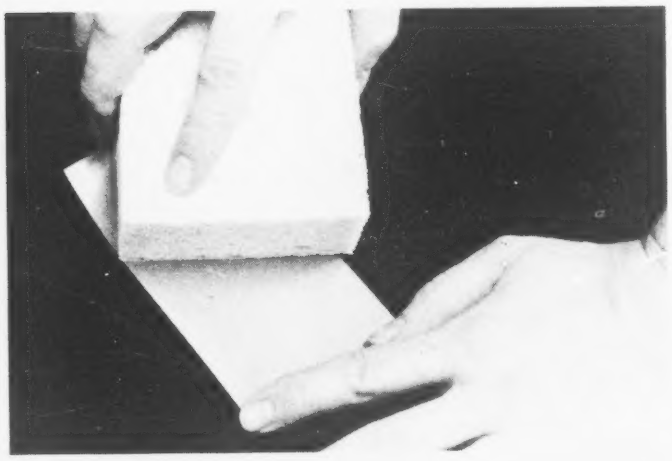


Fig. 4A-11. Dampening 5½″ Paper Tape

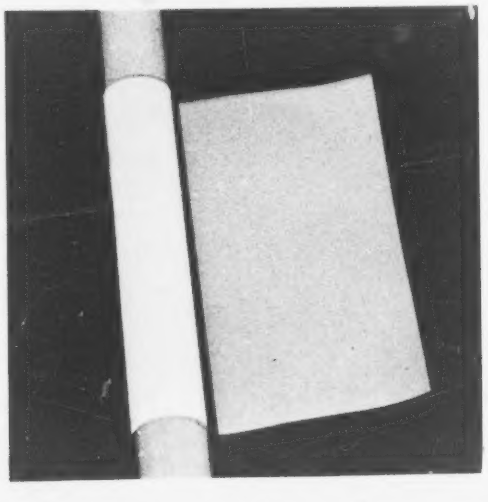


Fig. 4A-12. Positioning Sticky Paper Tape

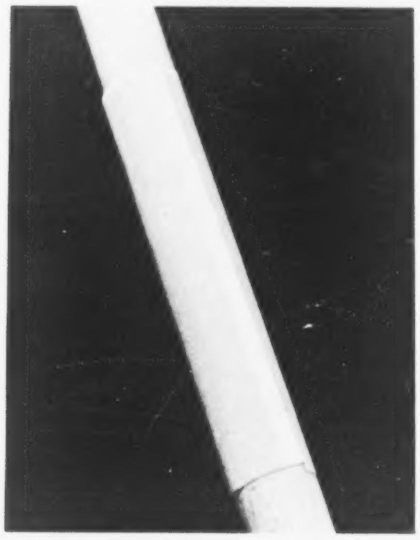


Fig. 4A-13. Rolling Tape over Dowel

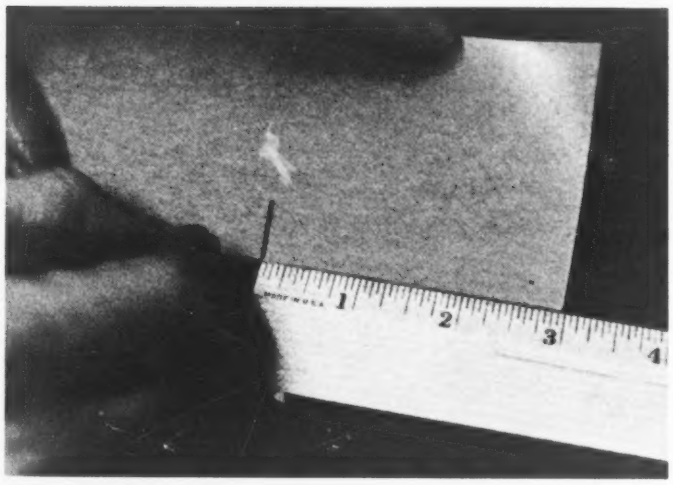


Fig. 4A-16. Marking Tape

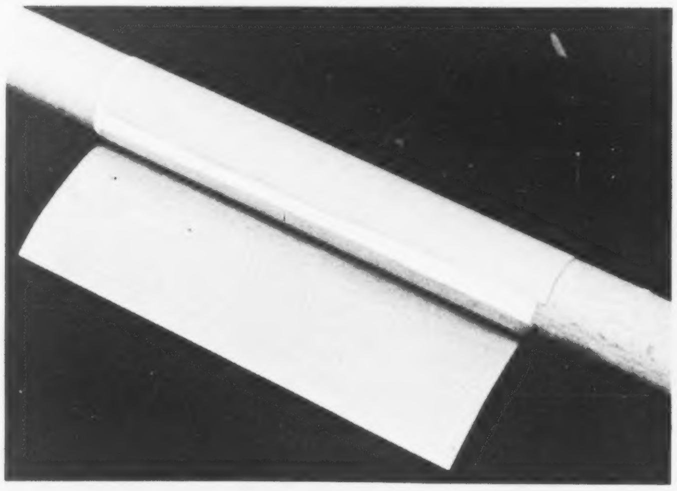


Fig. 4A-14. Positioning Second Piece of Tape

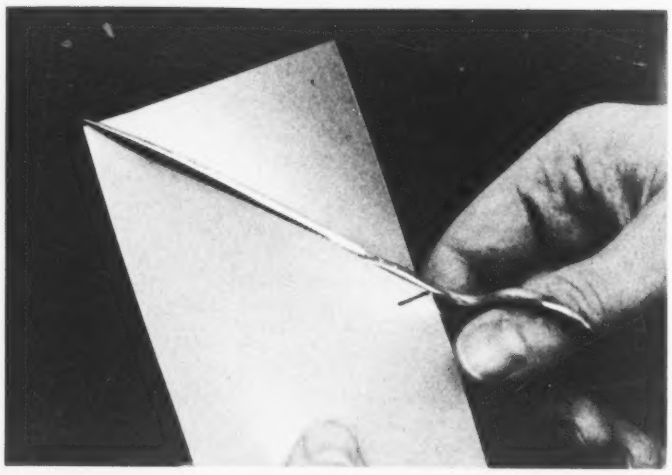


Fig. 4A-17. Cutting Angle

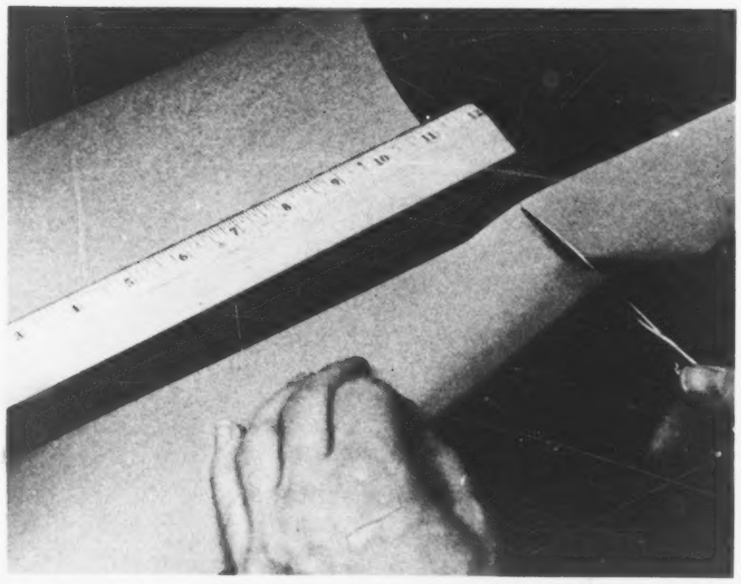


Fig. 4A-15. Cutting Gum Tape to Length

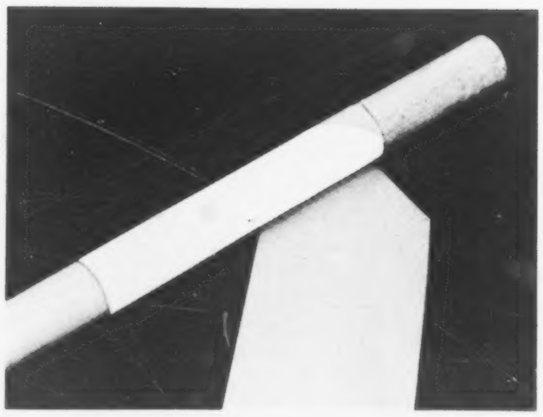


Fig. 4A-18. Positioning Angled Tape

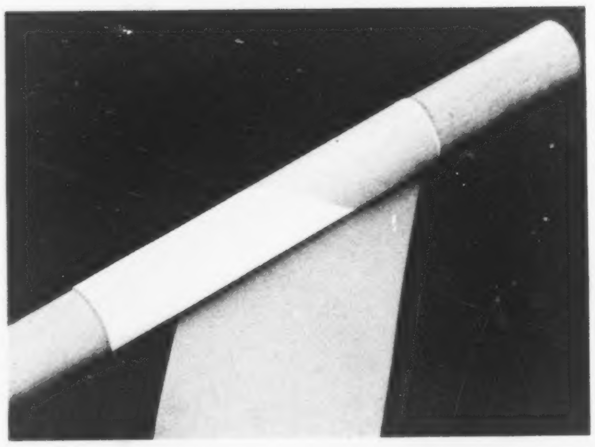


Fig. 4A-19. Rolling the Spiral

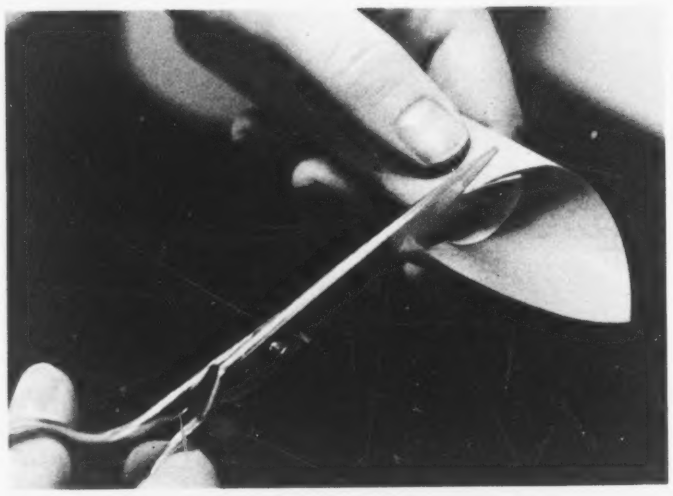


Fig. 4A-20. Trimming Ends of Tube

Problem 3

Objective

Using the four airframes produced in Problem No. 2, perform experiment (describe the weight, strength, shape, and surface smoothness of each) and determine the best airframe for use in a model rocket.

Equipment (Group of 5)
1 postal scale 16 oz. by ½ oz.
1 12″ rule

Supplies (Group of 5)
4 airframes
1 6″ pc. masking tape

Experimenting and Describing

1. Four qualities or properties will affect the way in which a model rocket performs. These are: (1) weight, (2) strength, (3) shape, and (4) surface smoothness.
2. *Weight.* The lighter the rocket, the higher it will fly. Compare the weight of the four airframes by weighing them on the postal scale. In Fig. 4A-21 record the weight of each airframe.

Fig. 4A-21. Comparison of Variables of Experimental Airframes

	Quality of Airframes					
Variables	Airframe #1	Airframe #2	Airframe #3	Airframe #4	Best Airframe	Second Best Airframe
Weight	oz.	oz.	oz.	oz.	#____	#____
Strength	oz.	oz.	oz.	oz.	#____	#____
Shape	Most round Round Not round Least round	Most round Round Not round Least round	Most round Round Not round Least round	Most round Round Not round Least round	#____	#____
Surface Smoothness	Smoothest Smooth Rough Roughest	Smoothest Smooth Rough Roughest	Smoothest Smooth Rough Roughest	Smoothest Smooth Rough Roughest	#____	#____

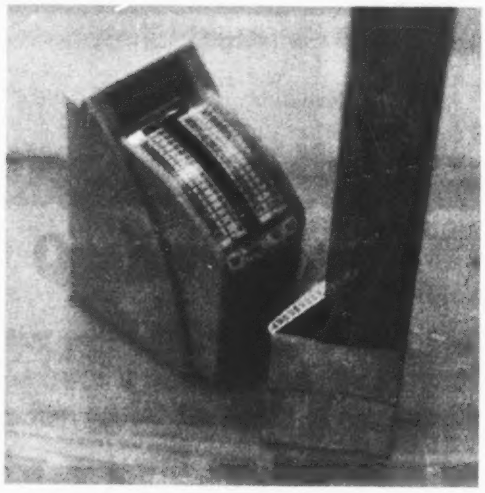


Fig. 4A-22A. Postal Scale and Airframe

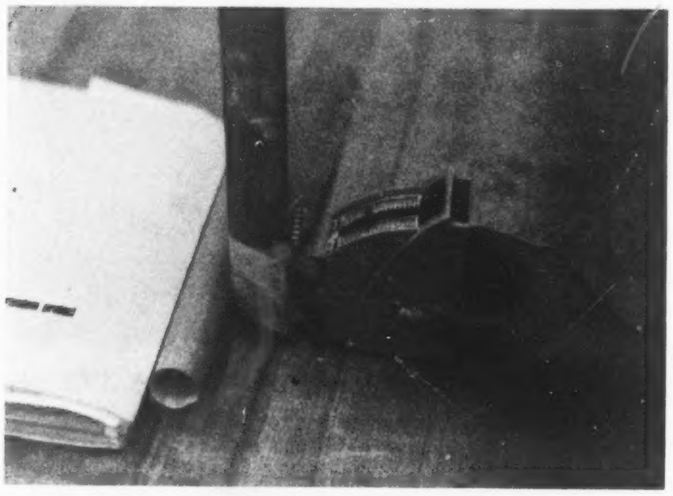


Fig. 4A-22B. Testing the Airframe

3. *Strength.* The stronger the construction of the rocket parts, the better they will perform during flight and handling. Set up the postal scale and airframe as shown in Fig. 4A-22. Place each airframe against a book and press the rule against the airframe. As soon as the airframe *starts to give* (dent), read the ounces of force. Record the ounces of force in Fig. 4A-21.
4. *Shape.* The more nearly round the airframe shape, the straighter it will fly. Look at both ends of each airframe and compare their shapes. In Fig. 4A-21, circle the word or phrase that best describes the shape of each airframe.
5. *Surface smoothness.* The smoother the surface of the airframe, the higher it will fly. Look at and feel the outside surface of the airframes. In Fig. 4A-21 circle the word that best describes the surface smoothness of each airframe.

Making a Decision

6. Compare the qualities of each airframe and decide which airframes are best and second best for each variable. Record your answers in Fig. 4A-21. The best airframe will be the one with the highest ratio between the lightest weight, strongest frame, most round shape, and smoothest surface.
7. Based on weight, strength, shape, and surface smoothness, which airframe would be best for a model rocket? (Answer here.)

Airframe #____________

Cleaning Up

8. Clean up the area and store the equipment and supplies according to your teacher's directions.

ACTIVITY 4C, D

Manufacturing Technology

Today you will manufacture airframes, cut the fins, assemble nose cones, and assemble airframes and fins for model rockets.

Problem

Objective

Using the necessary equipment and supplies, each group will produce one airframe, one nose cone, three tail fins, and one launch lug for each member of the group and assemble the parts.

Equipment (Group of 5)

2 pcs.	1″ x 12″ lacquered dowel
2 pr.	scissors
1	sponge
1	coping saw
2	X-acto® knives (utility knives)
1	12″ rule
2	straightedges
1	fin assembly fixture
1	hand drill
1	1/16″ twist drill

Supplies (Group of 5)

4 pcs.	8½″ x 11″ white bond paper, 20#
1 roll	3″ gummed paper tape
1 btl.	white glue
1 tube	household cement
5	paper towels
5	No. 12 corks
5	No. 8 corks
5	1″ dia. x ½″ dowel
2	paper soda straws
6 pcs.	1½″ x 12″ binder board, 3/32″ thick
1 sht.	abrasive paper, 100 grit
3	pencils
2	newspaper *or* cardboard, for backup of materials being cut with X-acto® knives

Preparing to Work

1. The foreman of each group should assign each member of his group a number from 1 to 5.
2. Each member should follow the procedures listed under his student number.

Student 1
Making Airframes

You are to help produce one airframe for each member of the group, and begin assembly of the fins and the airframe. Student 2 will work with you.

1. Fold sheets of paper lengthwise. Cut each sheet into two pieces, each 4¼″ x 11″ in size.
2. Lay the long side of one 4¼″ x 11″ piece of paper along a dowel. See Fig. 4C-1.
3. Roll the paper around the dowel and apply a narrow bead of glue. See Fig. 4C-2.
4. Press the seam together.
5. Wipe off extra glue with a damp paper towel. See Fig. 4C-3.

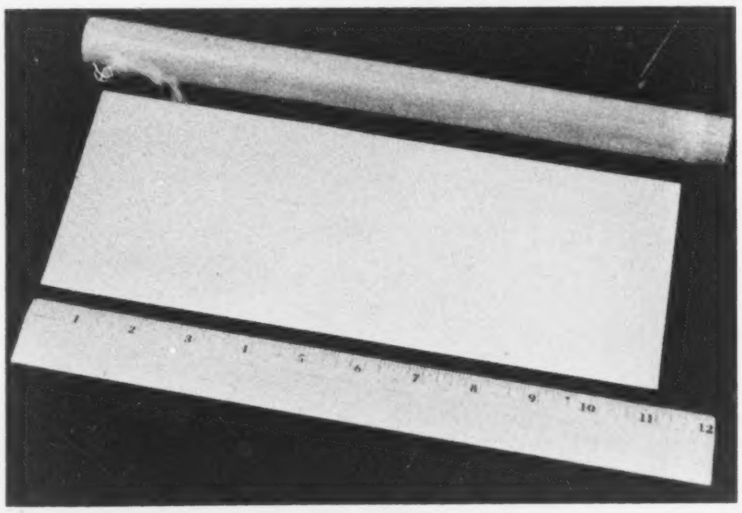


Fig. 4C-1. Positioning the Paper

6. Dampen a 3″ x 11″ piece of tape with a sponge.
7. Place the white paper tube and dowel near the sticky tape. See Fig. 4C-4.
8. Roll the dowel over the tape and smooth out any wrinkles.
9. Dampen a 3″ x 18″ piece of tape with a sponge.
10. Lay one end of the white paper tube over the angled end of the tape. See Fig. 4C-5.
11. Roll the dowel over the tape, winding the tape into a spiral around the tube. See Fig. 4C-6.

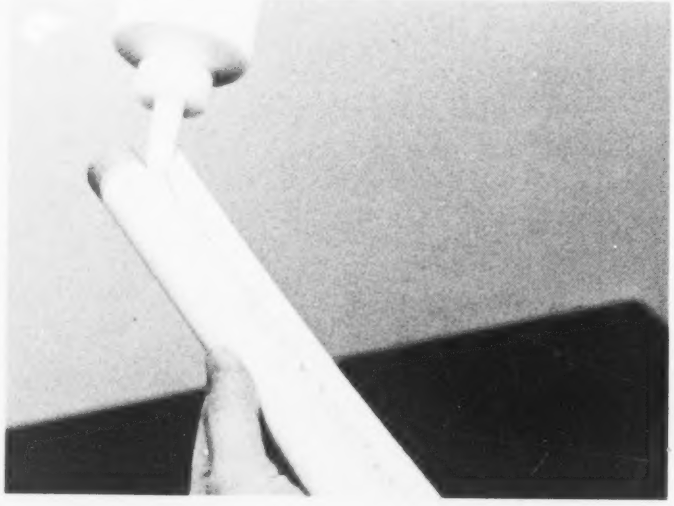


Fig. 4C-2. Rolling the Paper around the Dowel and Applying Glue

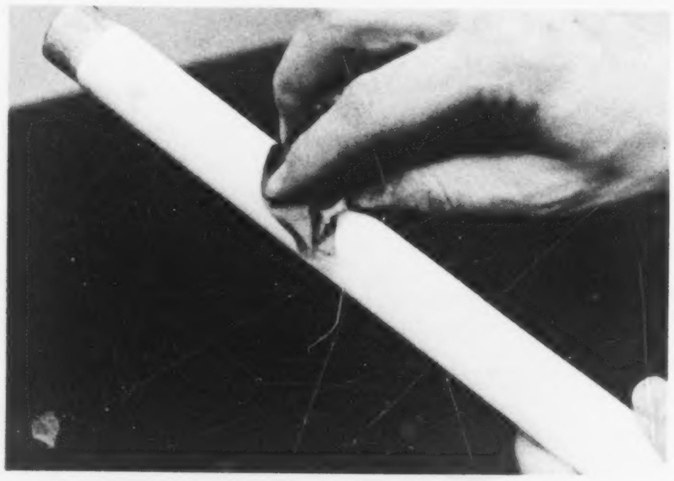


Fig. 4C-3. Removing Extra Glue

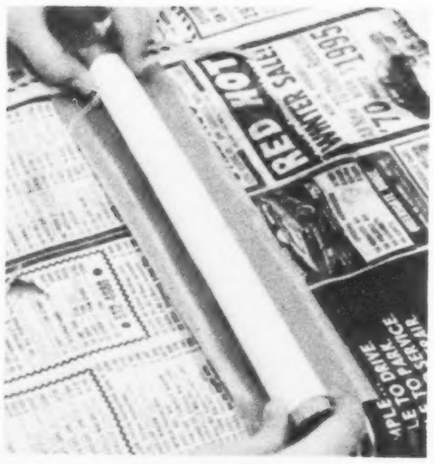


Fig. 4C-4. Positioning near Tape

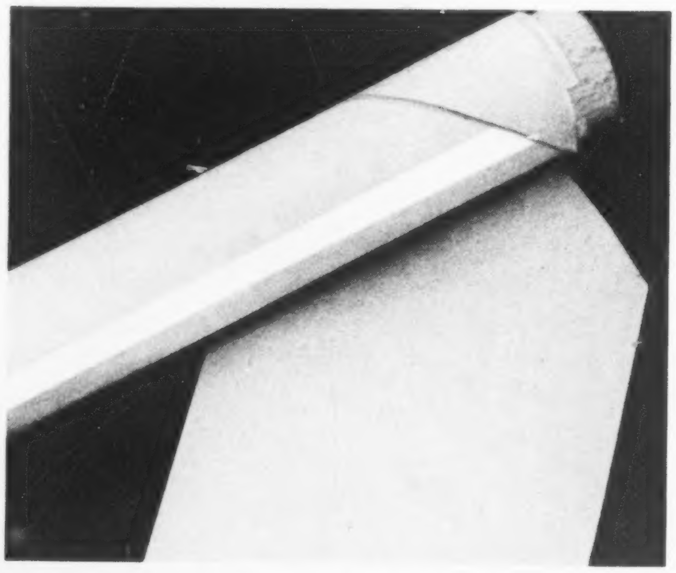


Fig. 4C-5. Positioning near Angled Tape

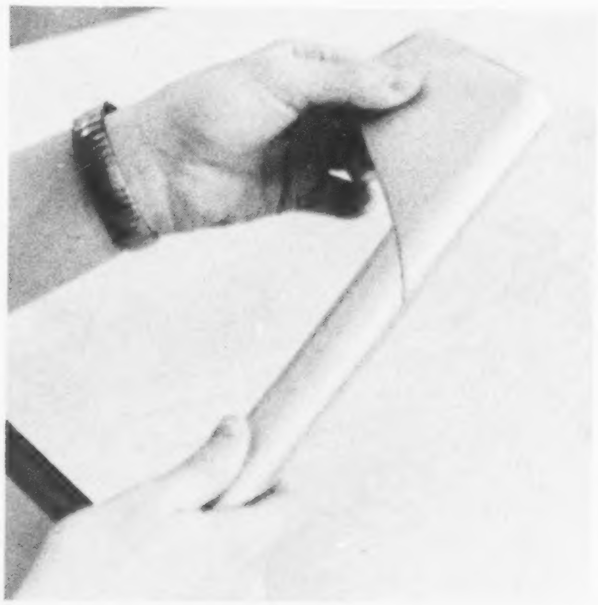


Fig. 4C-6. Rolling

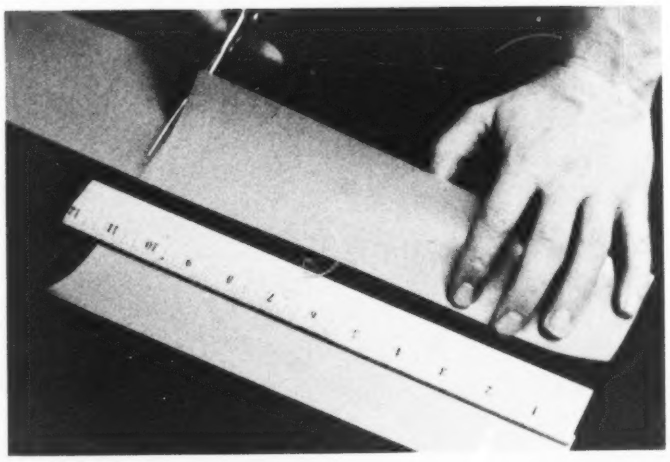


Fig. 4C-7. Cutting 11″ Tape

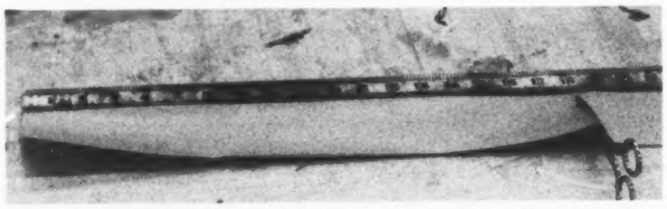


Fig. 4C-8. Cutting 18″ Tape

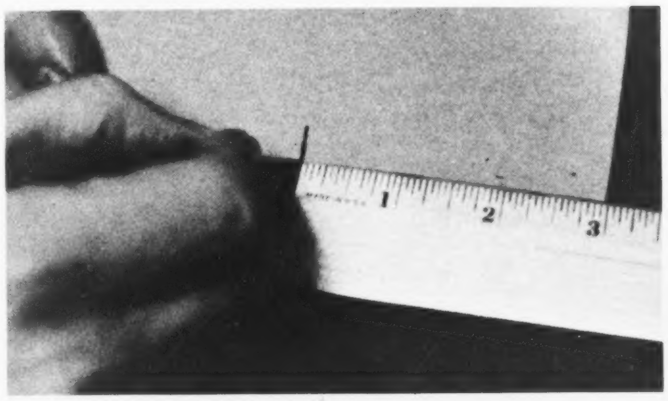


Fig. 4C-9. Marking the Tape

12. Smooth out any wrinkles. Remove the airframe from the dowel.
13. Repeat Steps 1-12 until an airframe has been made for each member of the group.
14. Clean up your work station.

Student 2
Making Airframes and Launch Lugs

You are to help produce one airframe and one launch lug for each member of the group. You will work with Student 1 in making the airframes.

1. Dampen four paper towels and a sponge.
2. Cut one piece of gummed tape 3″ x 11″ for each member of the group. See Fig. 4C-7.
3. Cut one piece of gummed tape 3″ x 18″ for each member of the group. See Fig. 4C-8.
4. Mark each long piece of tape 3″ from one end. See Fig. 4C-9.
5. Cut each long piece of tape at an angle between the mark and the opposite corner. See Fig. 4C-10.
6. Trim the ends of the airframes completed by Student 1. See Fig. 4C-11.

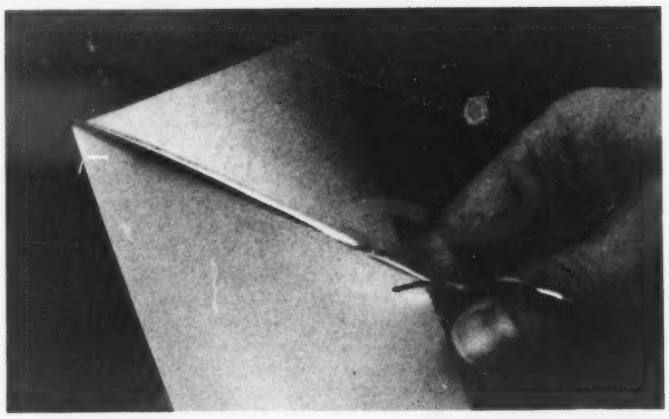


Fig. 4C-10. Cutting the Angle

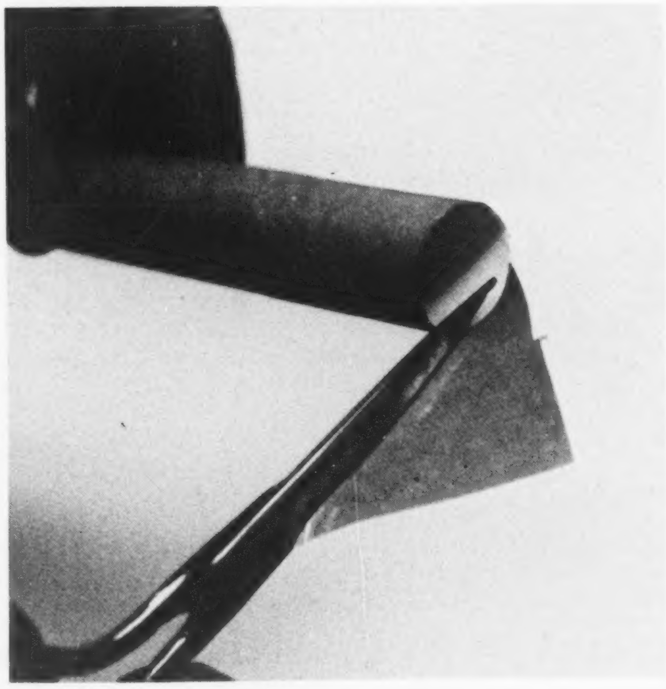


Fig. 4C-11. Trimming the Ends

7. Cut a 3¼″ length of soda straw to make a launch lug for each member of the group. See Fig. 4C-12.
8. Mark a center line on an airframe. See Fig. 4C-13.
9. Mark a point 3″ from the end of the tube. See Fig. 4C-14.
10. Apply a bead of white glue on one side of a launch lug. See Fig. 4C-15.
11. Center the launch lug along the line on the airframe. See Fig. 4C-16. Remove extra glue.
12. Complete assembly of airframes and launch lugs.
13. Clean up your work station.

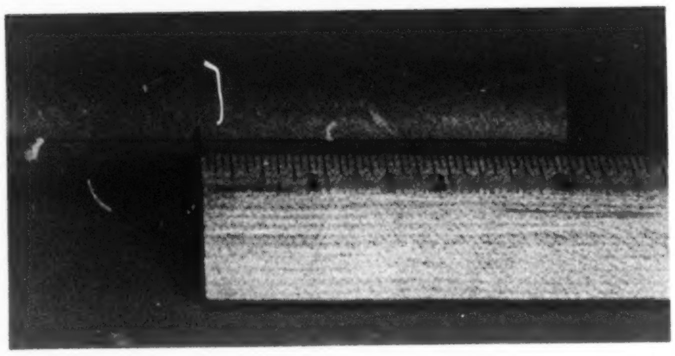


Fig. 4C-14. Marking a Point on the Center Line

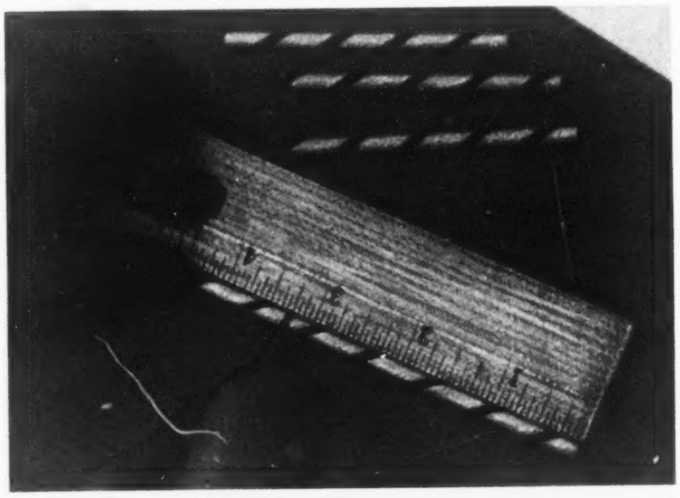


Fig. 4C-12. Cutting Soda Straw with X-acto® Knife

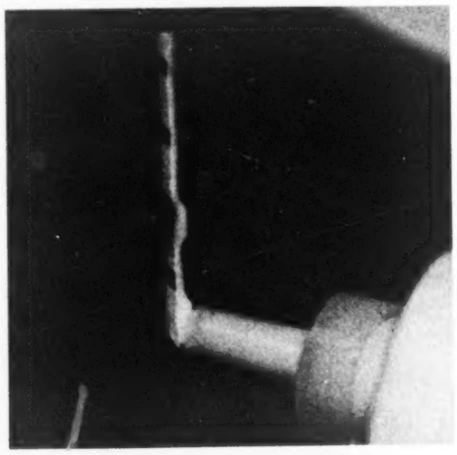


Fig. 4C-15. Applying Glue to the Launch Lug

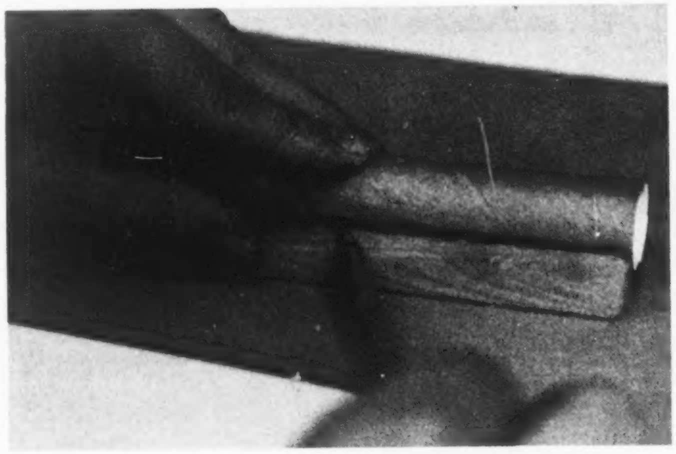


Fig. 4C-13. Marking a Center Line

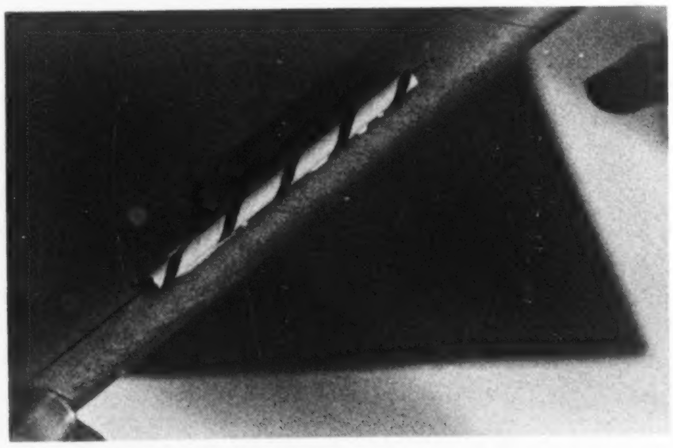


Fig. 4C-16. Centering Launch Lug on Center Line

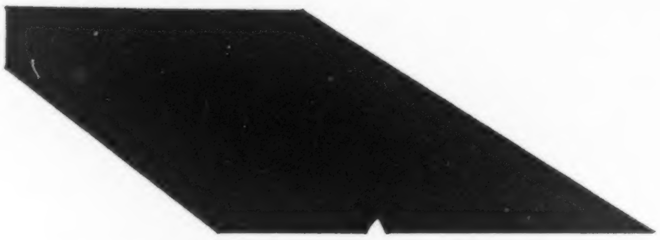


Fig. 4C-17. Fin Pattern
See Activity 4E, F, Fig. 4E-28 for full size layout.

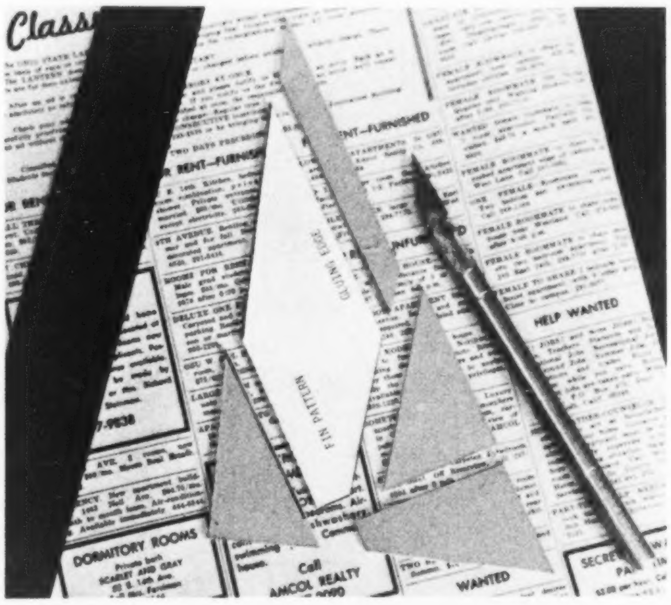


Fig. 4C-18. Cutting Out Fin Template

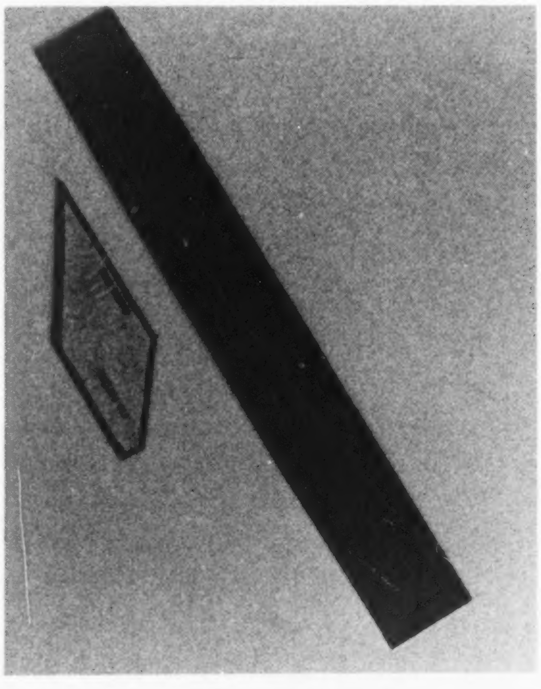


Fig. 4C-19. Layout on Binder's Board

Students 3 and 4
Making Tail Fins

You will cut three tail fins for each rocket produced by the group.

1. Cut out three tail fin patterns from the Laboratory Manuals. See Fig. 4C-17.
2. Glue the fins to cardboard with household cement.
3. Using a straightedge, utility knife and newspaper backing, cut out the fin templates. See Fig. 4C-18.
4. Lay out fin outlines on a 2½" x 12" strip of binder's board. See Fig. 4C-19.
5. Cut out the three fins using a straightedge and utility knife.
6. Repeat Steps 4 and 5 until a set of fins is made for each member of the group.
7. When finished cutting out fins, clean up your work area and put materials away. Then help Student 5 with the assembly of fins and airframes.

Student 5
Making Nose Cones and Assembling Tail Fins

You will make nose cones and assemble tail fins.

1. Glue a No. 12 and a No. 8 cork together, to form a cone. Use white glue. See Fig. 4C-20.

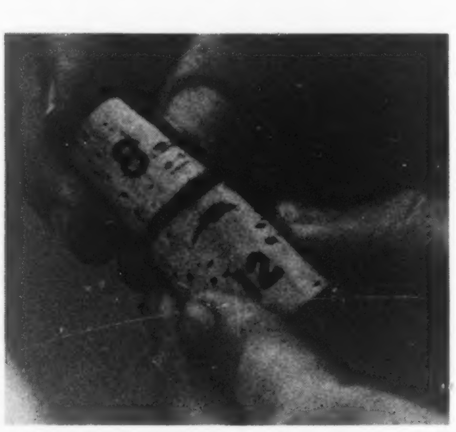


Fig. 4C-20. Assembling a Cone

2. Saw the dowel with a fine toothed saw. See Fig. 4C-21.
3. Glue the 1" dia. x ½" dowel to the cone. Use white glue. Make sure the dowel is centered. See Fig. 4C-22.
4. Repeat Steps 1-3 until a nose cone is assembled for each member of your group.
5. Store the assembled nose cones as directed by your teacher.
6. Place a completed airframe on a fin assembly fixture. See Fig. 4C-23.
7. Apply a bead of household cement to the notched edge of a fin. See Fig. 4C-24.
8. Attach the fin to the airframe in the assembly fixture. See Fig. 4C-25. Repeat Steps 7 and 8 for the other two fins.
9. Repeat Steps 6-8 until all fins are assembled to all airframes.

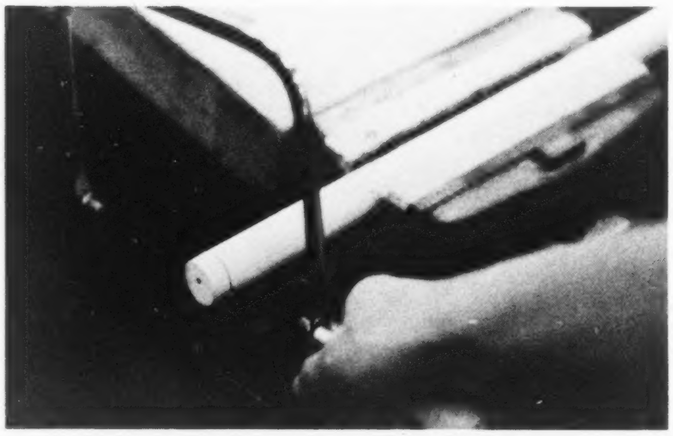


Fig. 4C-21. Sawing the Dowel

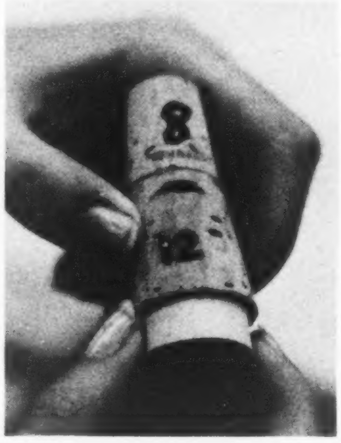


Fig. 4C-22. Gluing Dowel to the Cone

Cleaning Up

10. Clean up and store completed airframe-fin assemblies as directed by your teacher.

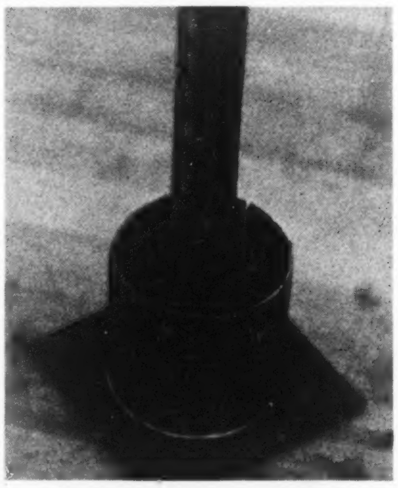


Fig. 4C-23. Airframe in Fin Assembly Fixture

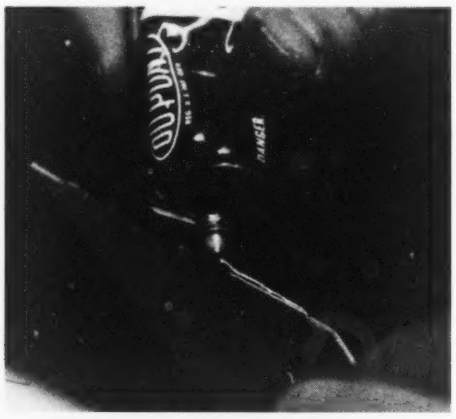


Fig. 4C-24. Applying Household Cement to Fin

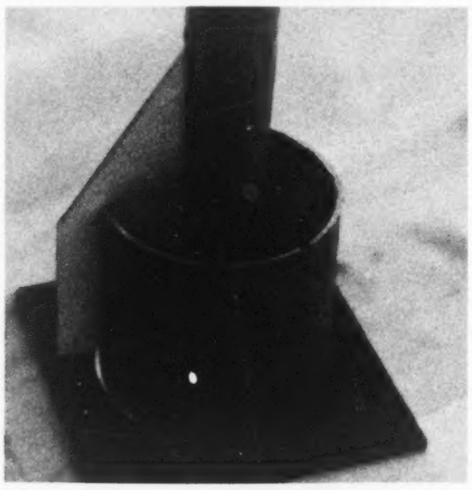


Fig. 4C-25. Attaching Fin to Airframe

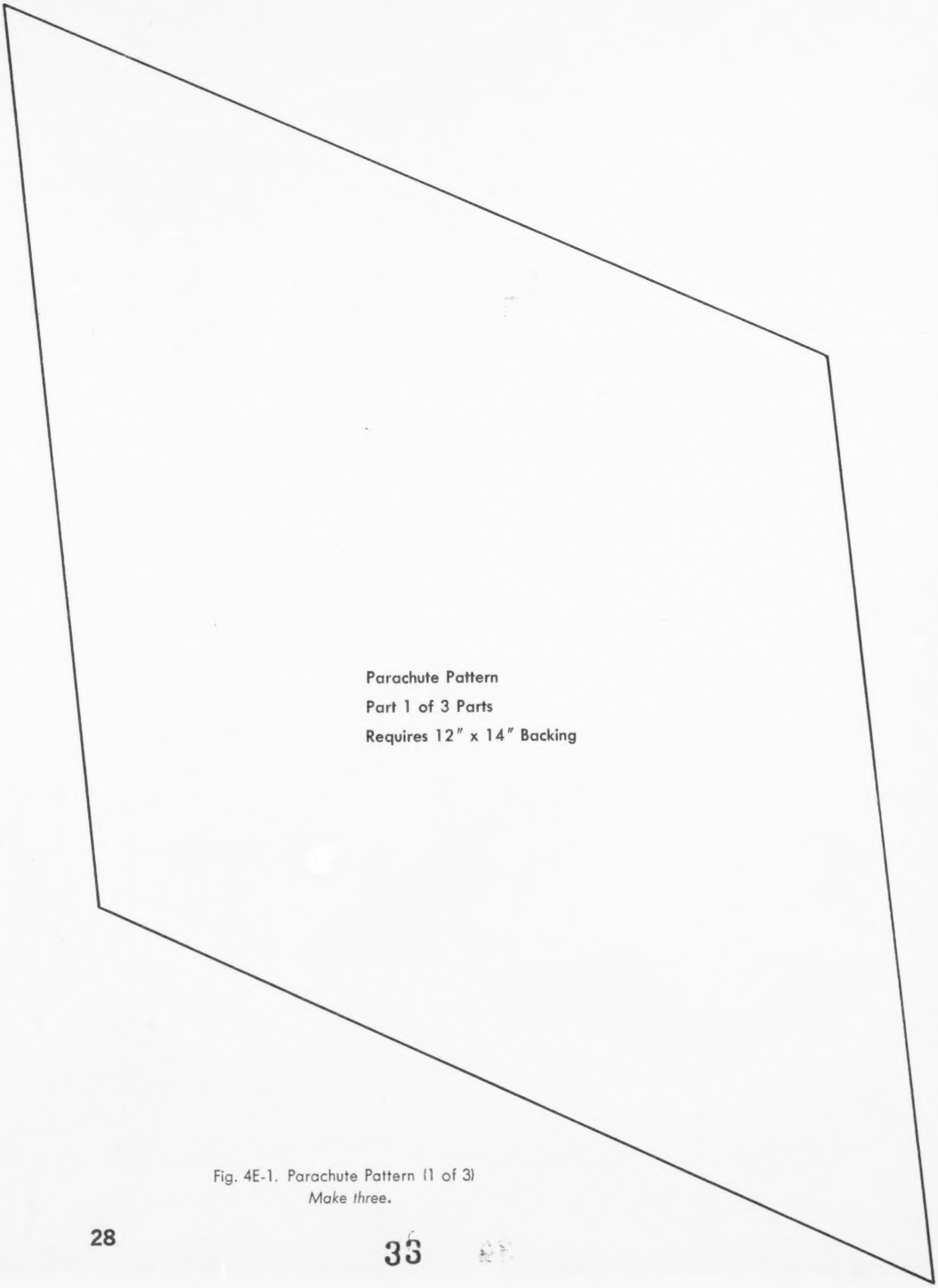

Parachute Pattern
Part 1 of 3 Parts
Requires 12″ x 14″ Backing

Fig. 4E-1. Parachute Pattern (1 of 3)
Make three.

ACTIVITY 4E, F

Manufacturing Management Technology

Today you will manufacture parachutes, complete production of nose cones, attach shock cords, and apply a finish coat to the model rocket.

Problem

Objective

Using the necessary equipment and supplies, Students 1 and 2 will manufacture parachutes, Student 3 will attach shock cords, Student 4 will complete production of the nose cones, and Student 5 will finish the airframe-fin subassembly.

Student 1

1. Obtain the following supplies and equipment from storage:

1 btl. white glue
1 roll masking tape
1 pc. binder's board
5 pcs. polyethylene film (dry cleaning bag)
1 pr. scissors
1 utility knife
1 straightedge
1 felt tip marker
newspaper or heavy cardboard

2. Cut out three parachute pattern pieces from the Laboratory Manuals and tape them together. See Fig. 4E-1 (PATTERN PAGE) and 4E-2.
3. Glue the parachute pattern to a piece of binder's board or heavy cardboard. See Fig. 4E-3.
4. Cut out the outline of the parachute with a utility knife and straightedge. Use

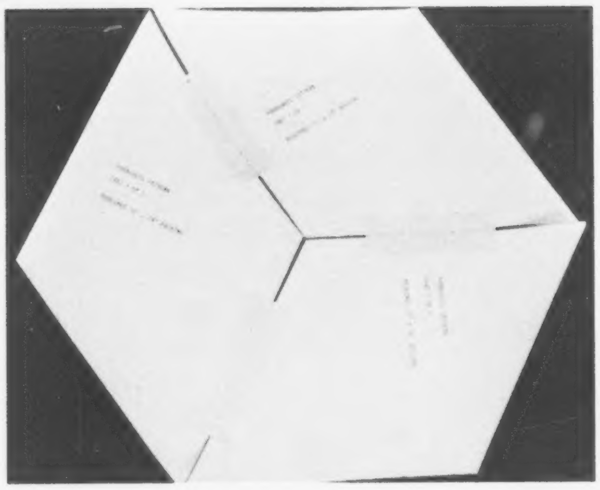


Fig. 4E-2. Assembled Parachute Pattern

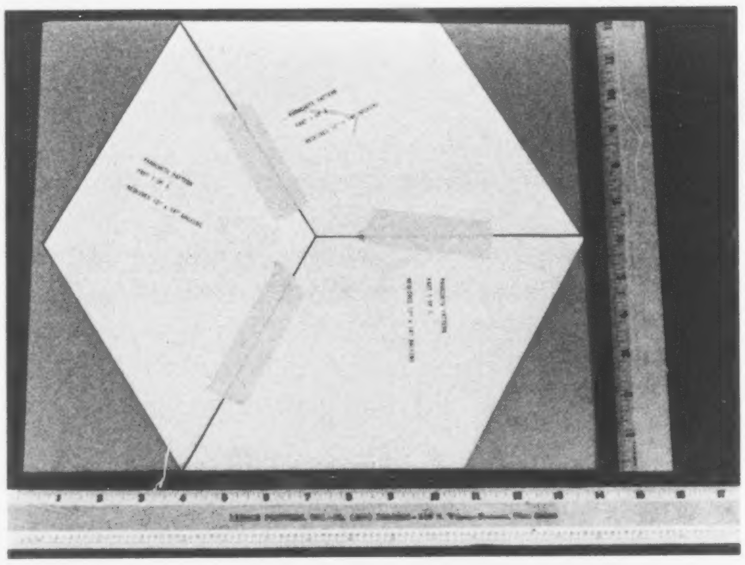


Fig. 4E-3. Mounting Pattern on Binder's Board

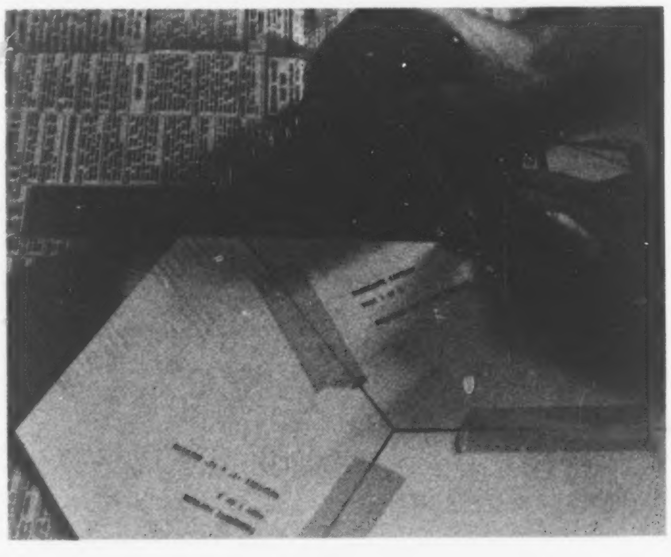


Fig. 4E-4. Cutting Binder's Board

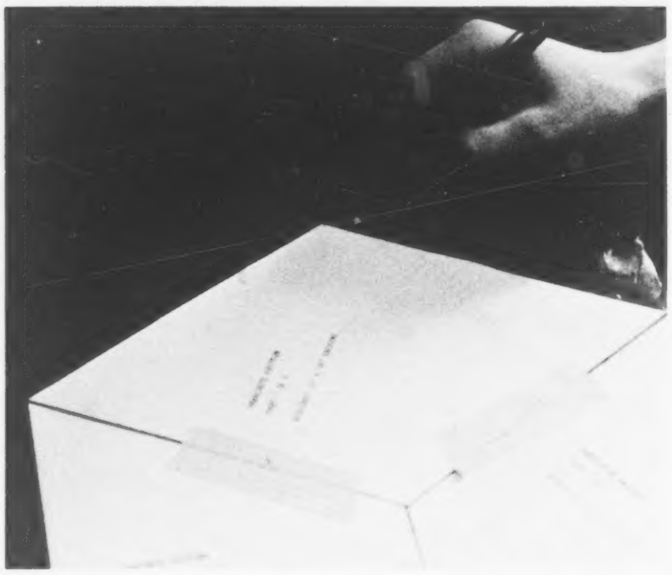


Fig. 4E-5. Marking Plastic Film

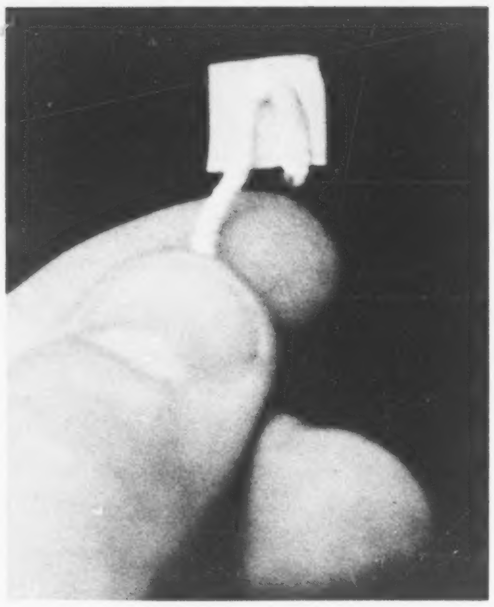


Fig. 4E-6. Forming a Loop in a Shroud Line

newspapers underneath to protect the table. See Fig. 4E-4.

5. Place the pattern over a piece of plastic film and lay out with a felt tip marker. See Fig. 4E-5.
6. Repeat Step 5 for each member of the group. Be sure to replace the cap on the felt tip marker.
7. Cut out the parachutes with scissors.
8. Clean up your work area.

Student 2

1. Obtain the following supplies and equipment from storage:

1 roll shroud cord
1 18″ rule or yardstick
1 pr. scissors

2. Measure and cut six pieces of shroud line 14″ long for each member of the group.
3. Cut six pieces of masking tape ½″ x ½″ for each member of the group.
4. Form a loop in one end of each shroud line and attach a piece of masking tape. See Fig. 4E-6.
5. Attach a shroud line to each corner of the plastic parachute. See Fig. 4E-7. Assist Student 1 in cutting out parachutes, if you are waiting.
6. Tie the ends of the shroud lines of each chute together. See Fig. 4E-8.
7. Store the parachutes as directed by your teacher.
8. Clean up your work area.

Student 3

1. Obtain the following supplies and equipment from storage:

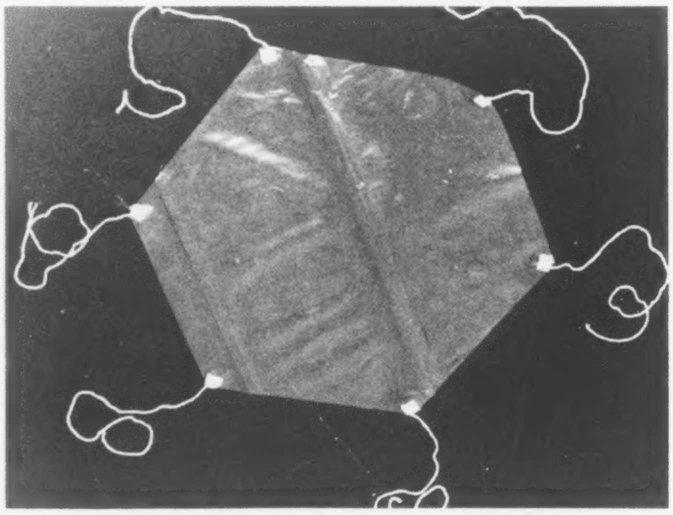


Fig. 4E-7. Attaching Shroud Line to Parachute

1 sht.	20# paper
5	⅛″ x 18″ shock cords
1	utility knife
1 pr.	scissors
1 pc.	¼″ x 6″ dowel
5	airframe-fin subassemblies

2. Cut out one shock cord anchor pattern from a Laboratory Manual. See Fig. 4E-9.
3. Glue the pattern to a piece of binder's board. Use a scrap from the binder's board for the parachute pattern.
4. Cut out the outline of the pattern with a utility knife and straightedge.
5. Using a pencil and the shock cord anchor pattern, lay out an anchor for each member of the group on a piece of 20# white paper. See Fig. 4E-10.
6. Cut out the anchors with scissors.
7. Apply glue to the small end of an anchor and attach one end of a shock cord. See Fig. 4E-11.
8. Bend the small end of the anchor over and apply glue to the middle section. See Fig. 4E-12.

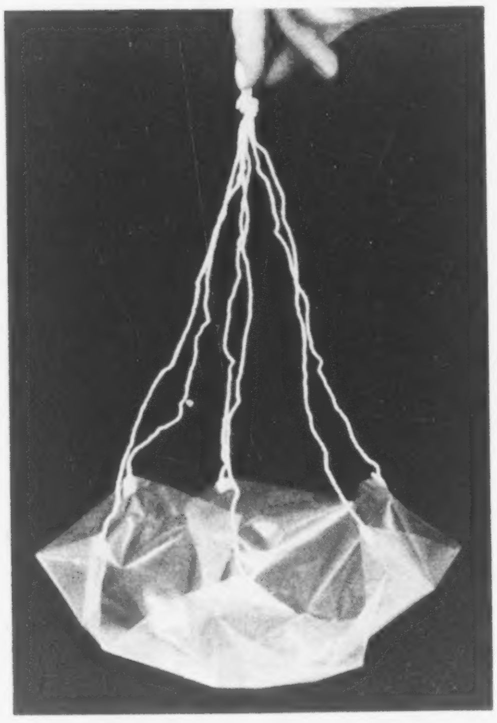


Fig. 4E-8. Tying Shroud Lines

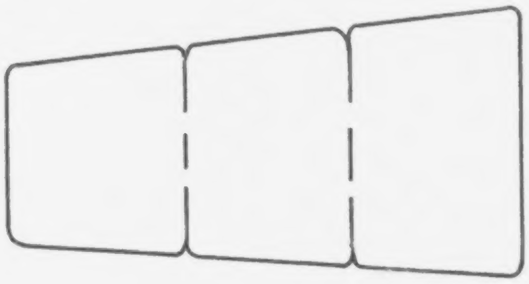


Fig. 4E-9. Shock Cord Anchor

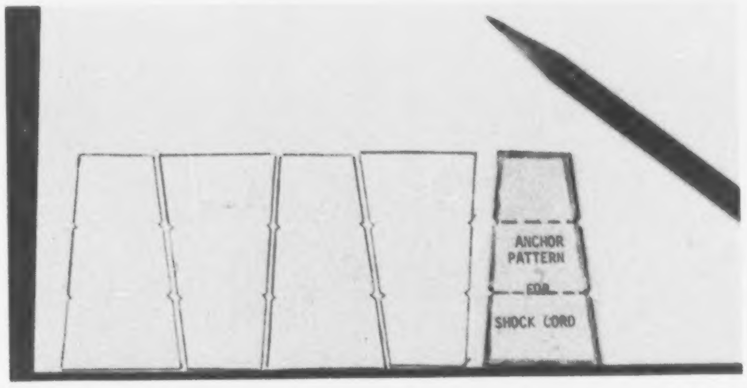


Fig. 4E-10. Laying Out Shock Cord Anchors

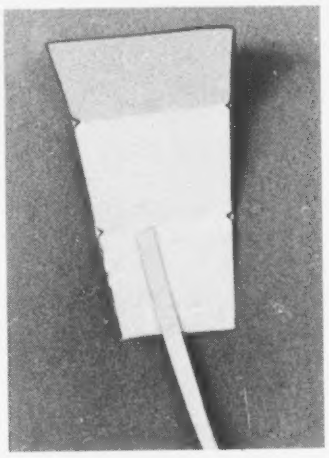


Fig. 4E-11. Gluing Shock Cord to Anchor (Step 1)

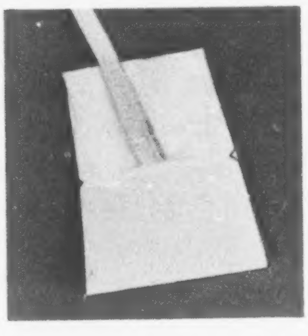


Fig. 4E-12. Gluing Shock Cord to Anchor (Step 2)

9. Bend the middle section over and apply glue to the side on which the shock cord is attached. See Fig. 4E-13.
10. Apply the glued surface of the anchor to the inside of the rocket airframes. The top of the anchor must be at least 1″ below the end of the tube. See Fig. 4E-14.
11. Press the anchor in place, using a piece of dowel.
12. Repeat Steps 6-10 until shock cords have been anchored to each airframe.
13. Clean up your work area.
14. Help Student 5 spray-paint the fin-airframe subassembly.
15. Clean up. Return equipment and materials to storage.

Student 4

1. Obtain the following supplies and equipment from storage:

5	cork nose cone subassemblies
5	screw eyes
1 sht.	abrasive paper
1	awl
1 pr.	pliers
1	file
1 pc.	30″, #18 soft iron wire *or* coat hanger
1 cup	enamel
1 cup	thinner
1	½ gal. milk carton
1	cardboard box

2. Round the small end of each nose cone using a file and abrasive paper. See Fig. 4E-15.
3. Punch a small hole in the center of the base of each nose cone, using an awl. See Fig. 4E-16.

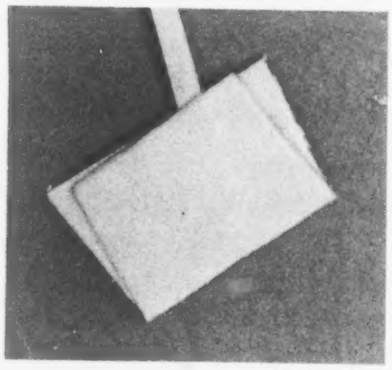


Fig. 4E-13. Gluing Shock Cord to Anchor (Step 3)

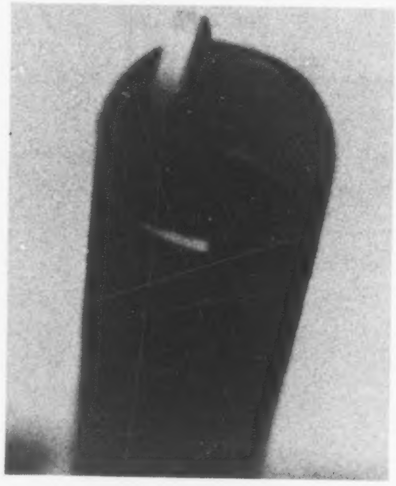


Fig. 4E-14. Gluing Anchor to Airframe

4. Coat the end of a screw eye with glue. Assemble the screw eye and nose cone. See Fig. 4E-17. Repeat for the remaining nose cones.
5. Cut and bend a wire hook for each nose cone. See Fig. 4E-18.
6. Dip-paint each nose cone as shown by your teacher. See Fig. 4E-19.
7. Apply a second coat of paint, if time permits.
8. Store nose cones to dry as directed by teacher.
9. Clean up. Return equipment and materials to storage.

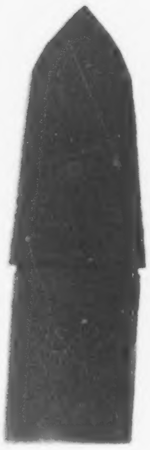


Fig. 4E-15. Shaped Cork Nose Cone

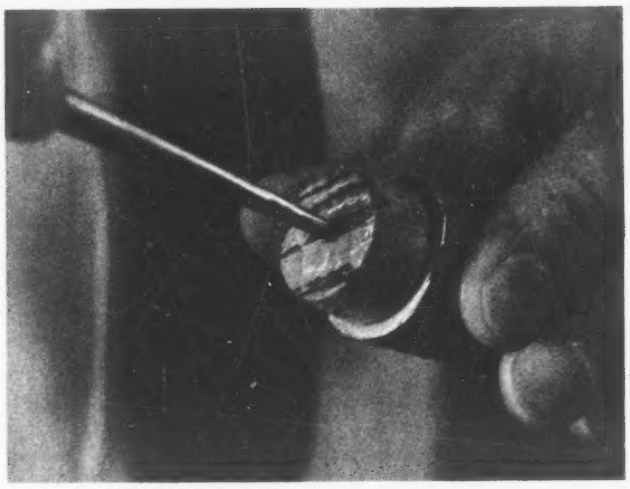


Fig. 4E-16. Making Anchor Hole for Screw Eye

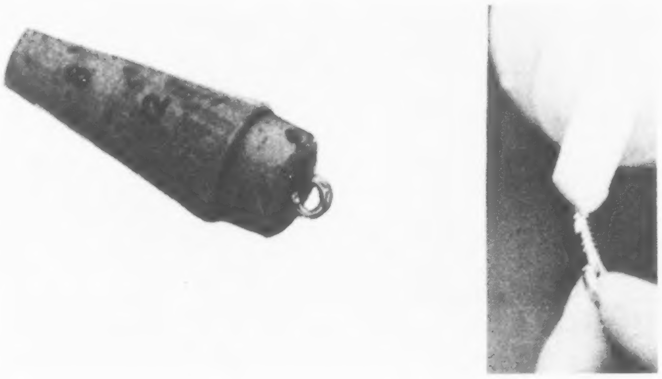


Fig. 4E-17. Assembling Eye and Nose Cone

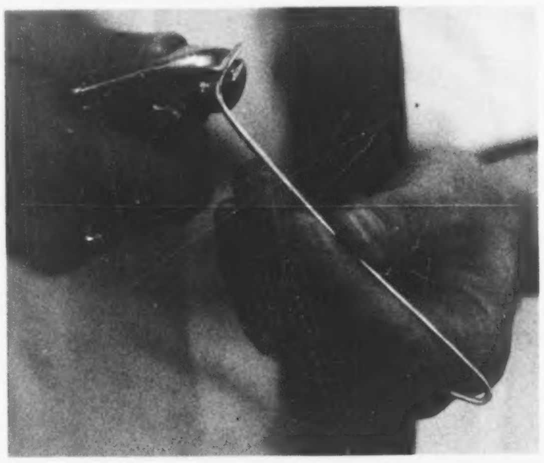
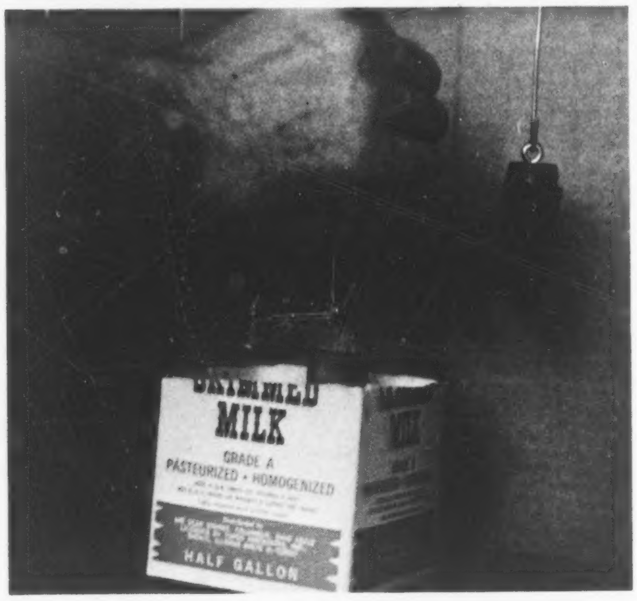


Fig. 4E-18. Making Wire Hooks



MILK
GRADE A
PASTEURIZED • HOMOGENIZED
HALF GALLON

Fig. 4E-19. Dip Painting Nose Cones

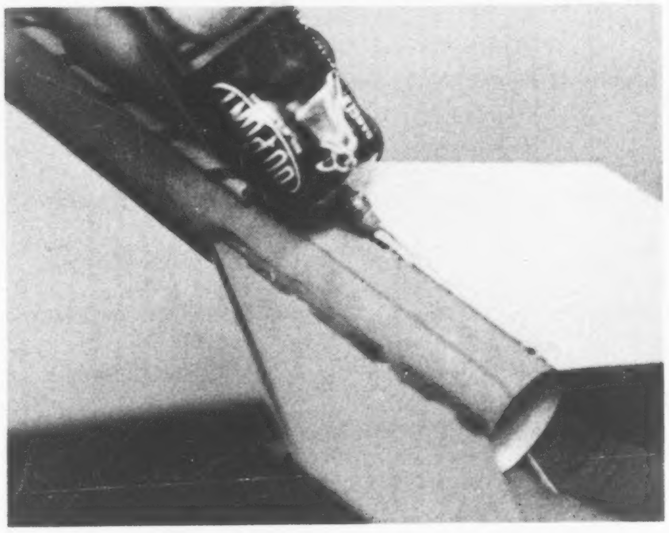


Fig. 4E-20. Applying Beads of Cement between the Fin and Airframe

Student 5

1. Obtain the following supplies and equipment from storage:

1 can spray paint
1 tube household cement
1 cardboard box

2. Apply beads of cement along the fins and airframe of each rocket. See Fig. 4E-20. Pass each completed assembly to Student 3 for mounting shock cords.
3. Spray-paint each fin-airframe-shock cord subassembly as directed by your teacher.
4. Store painted subassemblies as directed by your teacher.
5. Clean up. Return equipment and materials to storage.

NOTE: All Students

Your teacher will provide instructions for the final assembly of the rocket subassemblies. When the nose cone and airframe subassemblies are dry, the final assembly is completed as follows:

1. Tie the end of the shock cord to the nose cone eye. See Fig. 4E-21.
2. Tie the knotted end of the parachute shroud lines to the eye of the nose cone. See Fig. 4E-22.

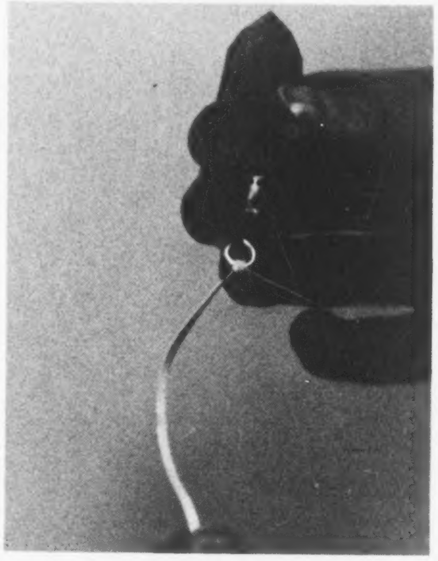


Fig. 4E-21. Tying the Shock Cord to Nose Cone

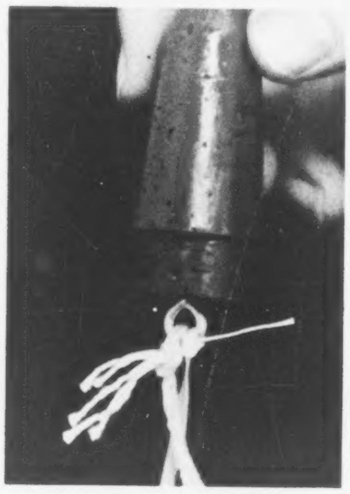


Fig. 4E-22. Tying Shroud Lines to Nose Cone

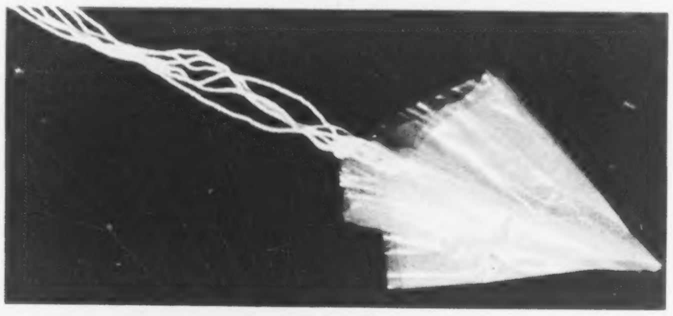


Fig. 4E-23. Laying Out the Parachute

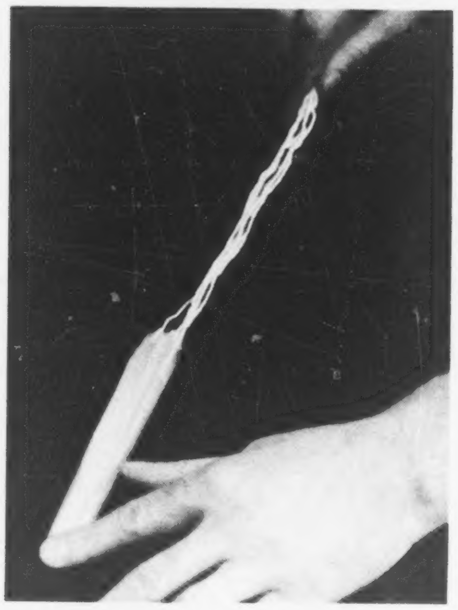


Fig. 4E-24. Parachute Folded with Shroud Lines at Center

3. Fold the parachute. See Figs. 4E-23 to 4E-26.
4. Place the folded parachute and shock cord inside the airframe. See Fig. 4E-27.
5. Fit the nose cone into the end of the airframe.
6. You may add decals to your rocket at home, if they are available.

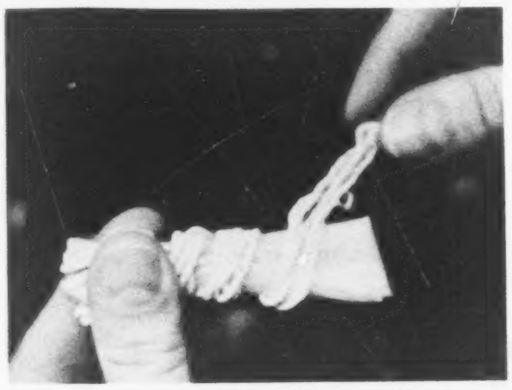


Fig. 4E-26. Wrapping Shroud Lines around Parachute

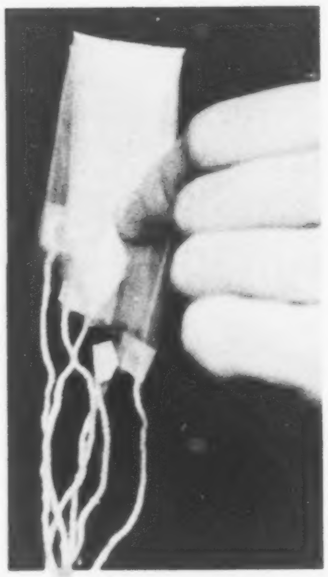


Fig. 4E-25. Folding Chute in Half

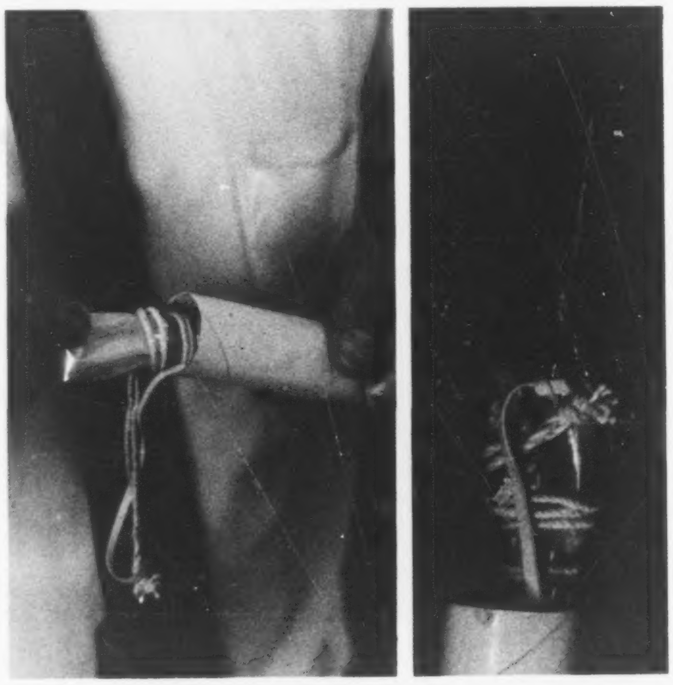


Fig. 4E-27. Placing Parachute and Shock Cord in the Airframe

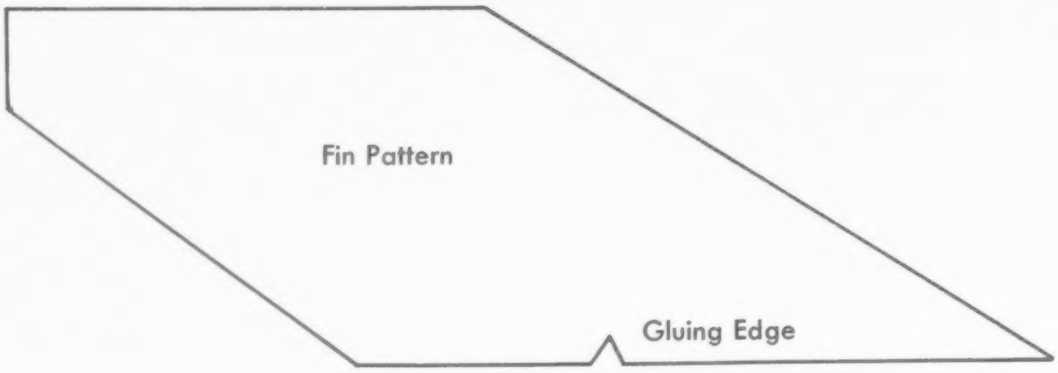


Fig. 4E-28. Fin Pattern

ACTIVITY 4G, H

Manufacturing Management Technology

This day will be used for one or more of the following activities:

1. Applying a second finish coat to completed IACP rockets, and assembling parts.
2. Producing engine mounts.
3. Producing altitude scopes.
4. Producing launch platforms.
5. Test-firing rockets.

Problem 1
Finish Coating and Assembling

Objective

Using the necessary equipment and supplies,

a. Apply finish coat (second coat) to nose cones by dipping.
b. Apply finish coat to airframe-fin-shock cord subassemblies by spraying.
c. Assemble the nose cones, parachute, and shock cord when finish coats are dry.

Supplies (Group of 5)

5	nose cone subassemblies
5	airframe-fin-shock cord subassemblies
5	parachute subassemblies
1 pt.	50-50 enamel and thinner
1 can	spray paint
5	wire paint hooks
2	boxes for dipping and spraying
1	½ gal. milk carton

Finishing

1. For applying finish to nose cones, get the nose cone subassemblies, wire hooks, enamel and thinner, ½ gal. milk carton, and a cardboard box. Then follow ACTIVITY 4E, F directions for Student 4, Steps 4-9.
2. For applying finish to airframe-fin-shock cord subassembly, get the subassemblies, spray paint, and a cardboard box. Follow Activity 4E, F directions for Student 5, Steps 3-5.

Assembling

3. For final assembly, get the nose cone, parachute, and airframe subassemblies. Follow Activity 4E, F directions for all students, Steps 1-6.

Problem 2
Engine Mounts

Objective

Using the necessary equipment and supplies, manufacture an engine mount for IACP rockets.

Equipment (Group of 5)

2	utility knives
2	12″ rules
1	C clamp
1 pr.	pliers

Equipment (Per class)

1	miter box
1	drill press
1	¼″ drill

Supplies (Group of 5)

1	0.710″ inside dia. x 18″ paper tube
1	pencil
1 pc.	1″ x 6″ heavy paper
1 pc.	⅝″ dia. dowel, 3″ long
1 btl.	white glue
50″	⅛″ x ⅛″ lightweight softwood

Supplies (Per class)

1	1″ dia. dowel, 7½″ long (¼″ per student)

Your teacher will tell you how many engine mounts to make for your group or for the class.

Student 1
Making Tubes for Engine Mounts

1. Get engine mount tubes, a pencil, utility knife, ⅝″ dowel, and a strip of paper. You will be cutting engine mount tubes to length.
2. Measure and mark one 18″ tube into sections 2½″ long. See Fig. 4G-1.
3. Wrap a strip of paper around the tube, with the edge of the strip in line with a mark. See Fig. 4G-2.
4. Draw a line completely around the tube. See Fig. 4G-3. Remove the paper strip.
5. Slide a ⅝″ dowel into the tube far enough to go beyond the line to be cut.
6. Cut lightly around the line with a utility knife, rolling the tube as you cut. Do not

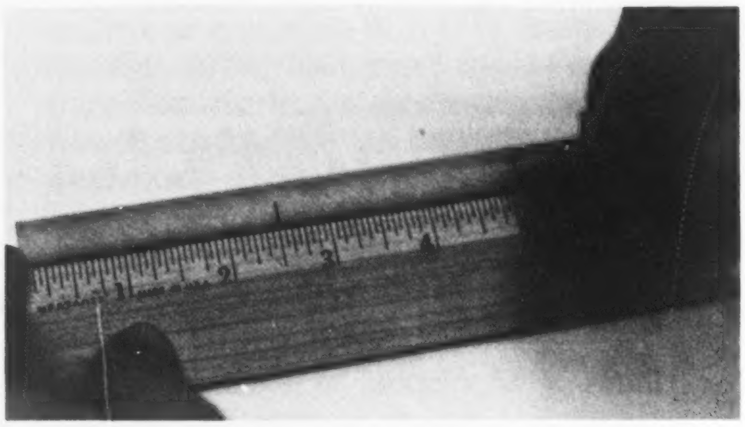


Fig. 4G-1. Making Tube into 2½″ Lengths

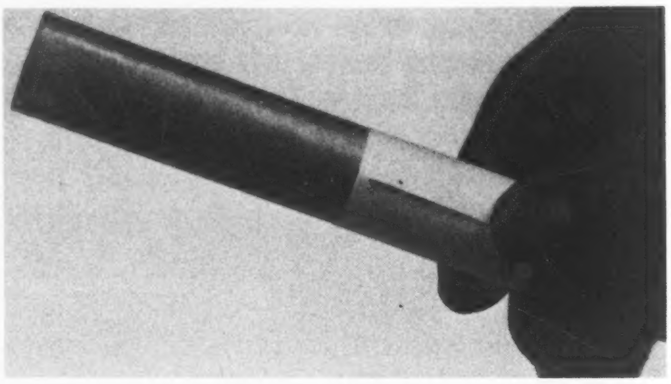


Fig. 4G-2. Location of Paper Strip

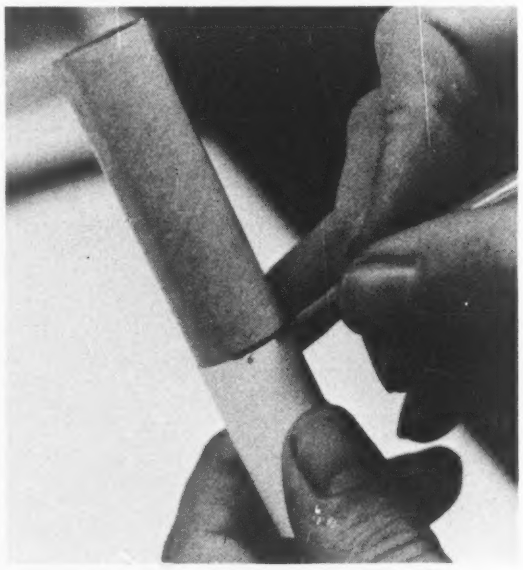


Fig. 4G-3. Drawing Line around Tube

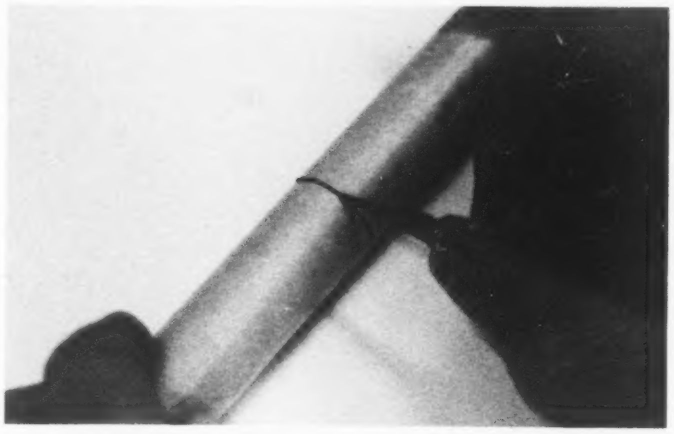


Fig. 4G-4. Cutting Tube

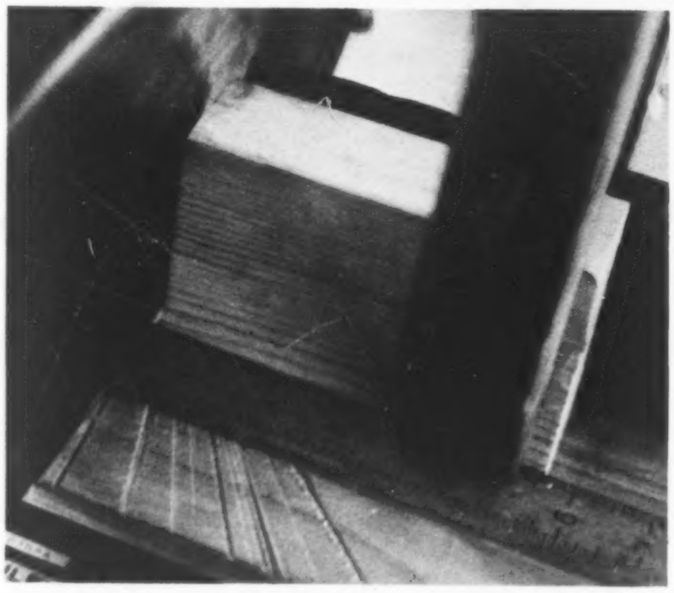


Fig. 4G-5. Stop Block Clamped ¼″ from Saw

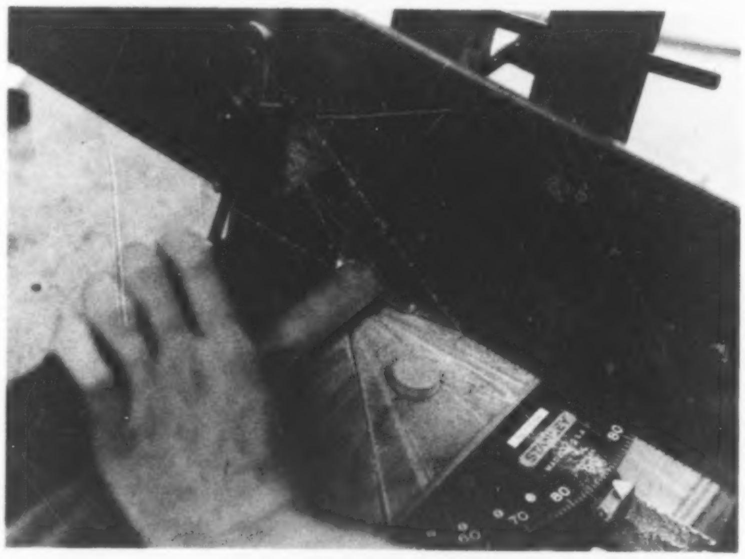


Fig. 4G-6. Sawing Dowel

try to cut completely through the tube with one cut. See Fig. 4G-4.

7. Remove the dowel. Pass the cut tube to Student 4.
8. Repeat Steps 3-7 until you have cut the number of sections directed by your teacher (one for each engine mount).
9. Clean up. Put supplies and equipment away.

Student 2
Cutting Disks

1. Get a 1″ dowel, miter box, clamp and stop block, and a rule.
2. Clamp a stop block on the miter box ¼″ away from the saw blade. See Fig. 4G-5.
3. Place a 1″ dowel in the miter box with one end against the stop block. See Fig. 4G-6.
4. Saw a ¼″ disk off the end of the dowel. Pass the disk to Student 3.
5. Repeat Steps 2 and 3 until you have cut the number of disks directed by your teacher (one for each engine mount).
6. Clean up. Put supplies and equipment away.

Student 3
Drilling Holes in Disks

1. Set up a ⅜″ drill in the drill press. Place a scrap piece of wood stock on the table of the drill press.

NOTE: It is suggested that the diameter of the hole in the rocket engine mount be ⅜″ to assure parachute ejection. A smaller size hole may cause the engine to be ejected rather than the nose cone and parachute. Check the drill size with your teacher.

2. When you receive a piece of dowel from Student 2, drill a hole through the center, holding the disk with pliers. See Fig. 4G-7.
3. Pass the drilled disk to Student 5.
4. Repeat Steps 2 and 3 until all disks have been drilled.
5. Clean up. Put supplies and equipment away.

Student 4
Making Engine Mount Parts

1. Get lengths of 1/8" x 1/8" wood, a rule, utility knife, and a piece of heavy cardboard.
2. Measure 2½" lengths along the 1/8" x 1/8" wood strip. See Fig. 4G-8.
3. Cut four strips to length with a utility knife. See Fig. 4G-9.
4. Pass the four pieces of wood to Student 5.
5. Repeat Steps 2-4 until four pieces have been made for each engine to be produced.

Student 5
Assembling Engine Mounts

You will receive parts from Students 1, 3, and 4.

1. Get newspapers or paper towels to cover your work area, and a bottle of white glue.
2. Apply glue to one side of four 1/8" x 1/8" strips and attach the strips to a tube. See Fig. 4G-10.
3. Apply a bead of glue to one side of a drilled dowel disk and attach the disk to

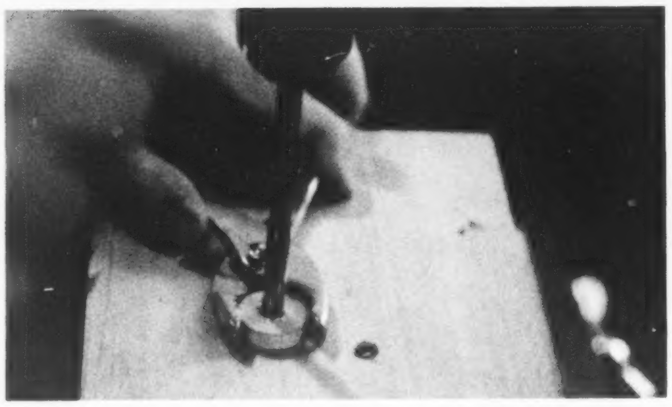


Fig. 4G-7. Drilling Hole in Dowel

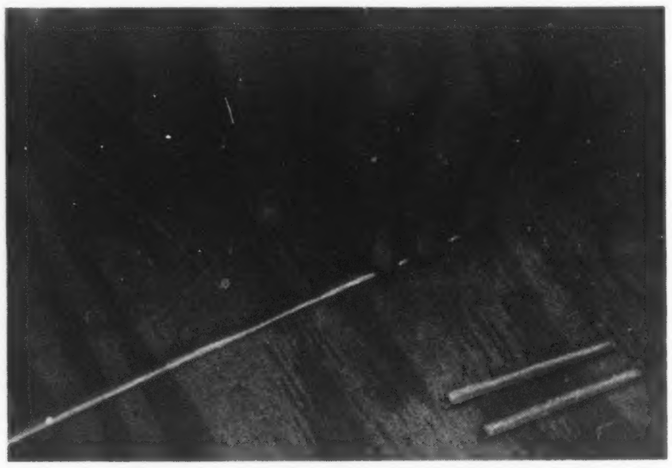


Fig. 4G-9. Cutting 2½" Lengths

Fig. 4G-8. Marking 2½" Lengths

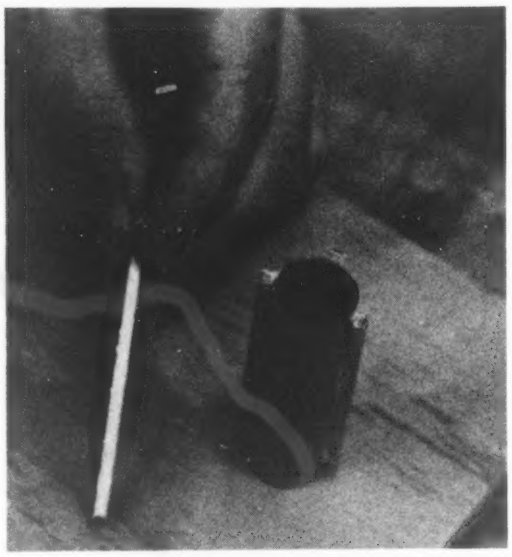


Fig. 4G-10. Glue Applied to Strips

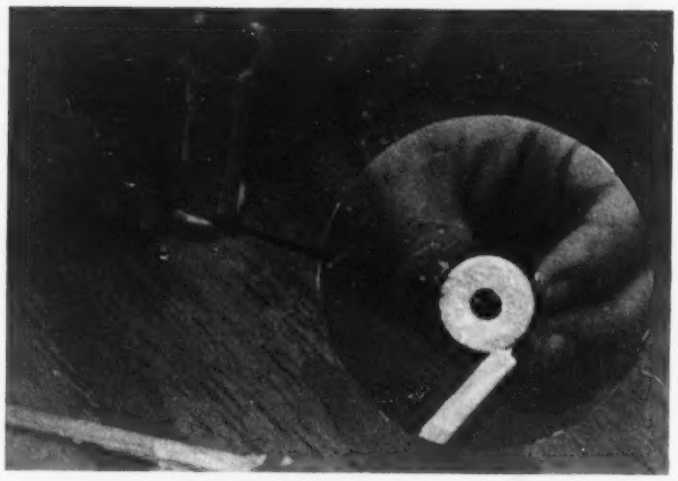


Fig. 4G-11. Gluing Tube to Disk

one end of the tube. See Fig. 4G-11. Set the completed engine mount aside to dry.

4. Repeat Steps 2 and 3 until all engine mounts are complete.
5. Clean up. Put supplies and equipment away.

Problem 3 Altitude Scope

Objective

Using the necessary equipment and supplies, manufacture altitude scopes.

Equipment (Group of 5)

4 pr.	scissors
1	3/16″ drill bit
1	hand drill
2	½″ x 8″ dowel mandril
1	12″ rule
1	⅛″ drill bit
1	center punch
1	ball peen hammer
1 pr.	tin snips
1	scriber
1	mill file

Supplies (Group of 5)

1 roll	gummed paper tape
1 btl.	white glue
5 shts.	4¼″ x 7″ white paper
5 pcs.	½″ x 1″ x 6½″ softwood
5 shts.	7″ x 7″ cardboard
5 pcs.	28 ga. 2½″ x 6″ galvanized iron
5	6-32 x 1″ RH machine screws
5	6-32 hex nuts
5	6-32 wing nuts

Your teacher will tell you how many altitude scopes to make for your class or for the group.

Students 1 and 2 Making Sight Tubes

You will be making a sight tube for each member of the group. The tubes will be made in the same way as the rocket airframes.

1. Get two ½″ dowels, a roll of gummed tape, a sponge, sheets of white paper, one bottle of white glue, and two pairs of scissors.
2. Shear the gummed tape to a 7″ length and a 10″ length for each tube.
3. Wrap the white paper around the ½″ dowel and glue the seam.
4. Moisten a piece of 3″ x 7″ tape with a sponge and roll it on to the white tube.
5. Dampen a piece of 3″ x 10″ tape and roll it in a spiral around the tube.
6. Trim the ends of the tube with scissors.

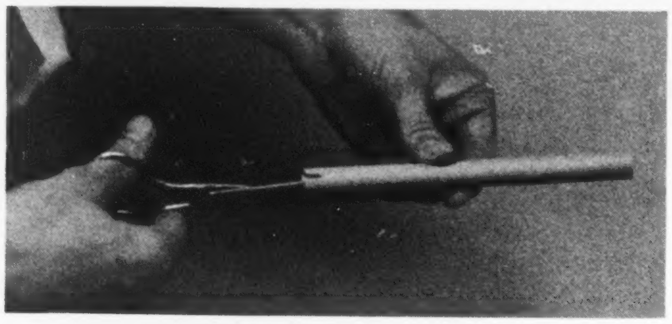


Fig. 4G-12. Cutting ¼″ Slots

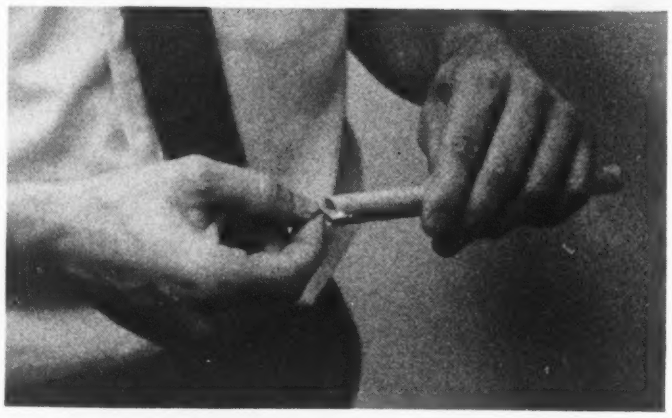


Fig. 4G-13. Gluing Sight in Tube

7. Repeat Steps 3-6 until all tubes are completed.
8. Cut a slot in one end of the completed tubes ¼″ deep. See Fig. 4G-12.
9. Cut a ¼″ x ½″ cardboard sight for each tube.
10. Glue the sight in the slotted end of each tube. See Fig. 4G-13.
11. Pass the completed tubes to Student 3.
12. Clean up. Put supplies and equipment away.

Student 3

Making the Scale

1. Obtain sheets of cardboard, one pair scissors, one hand drill, one ⅛″ twist drill, and five pieces of wood.
2. Cut a calibrated panel from a Laboratory Manual for each scope to be produced. See Fig. 4G-14 for template pattern of scale.

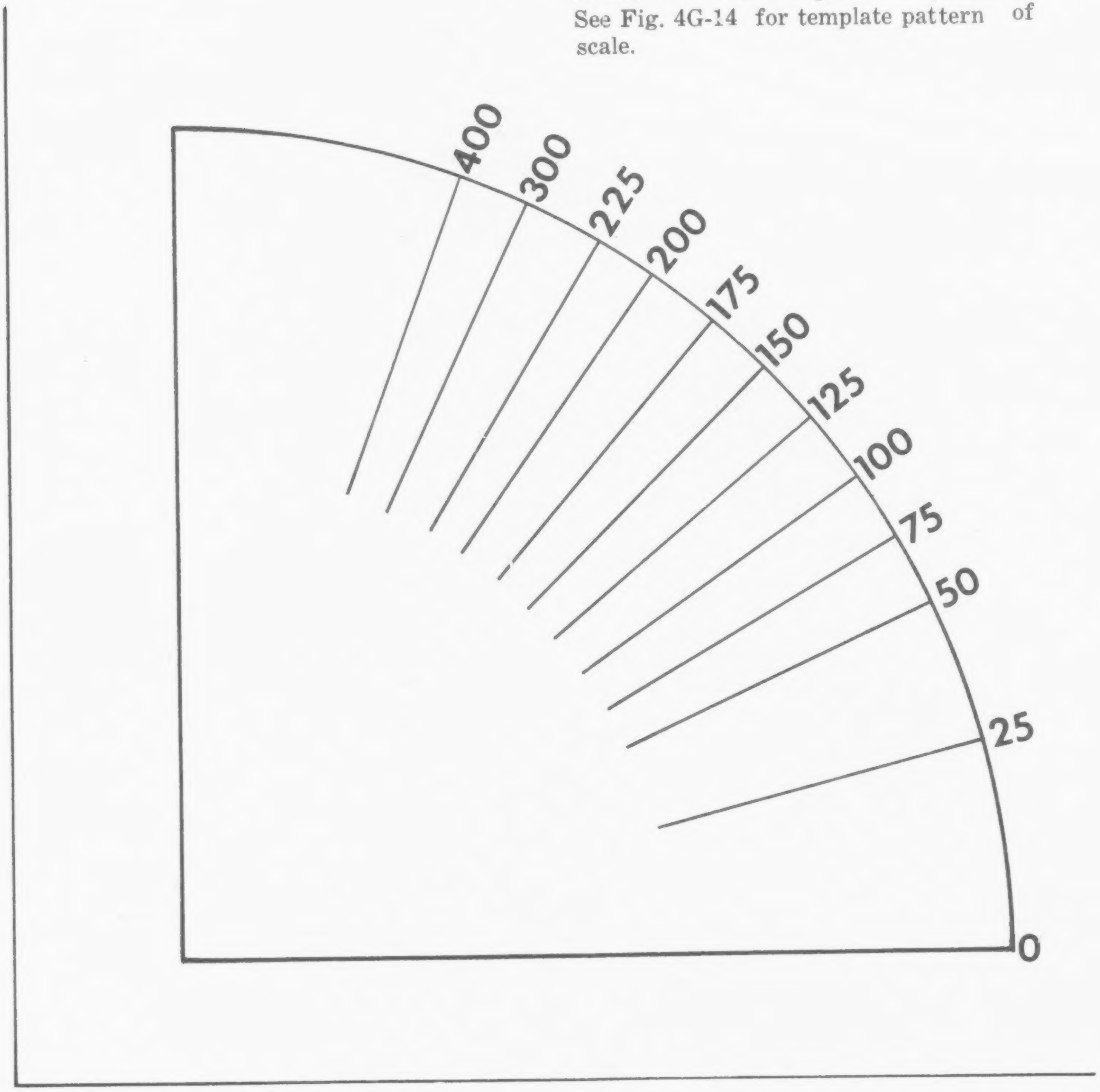


Fig. 4G-14. Altitude Scope Calibrated Scale

3. Glue each panel to a piece of cardboard.
4. Trim the cardboard to the outline of the calibrated panel. See Fig. 4G-15.
5. On the back of the cardboard draw a line ½″ from the top edge of the altitude scope calibrated panel. See. Fig. 4G-16.
6. Glue a piece of wood ½″ x 1″ x 6½″ to the back of the cardboard with the top edge of the wood along the bottom of the line. See Fig. 4G-17.
7. Drill a ⅛″ hole in the corner of the calibrated limits. See Fig. 4G-18.
8. Glue the sight tubes to the top edge of the wood strip. See Fig. 4G-19.
9. Clean up. Return supplies and equipment to storage.

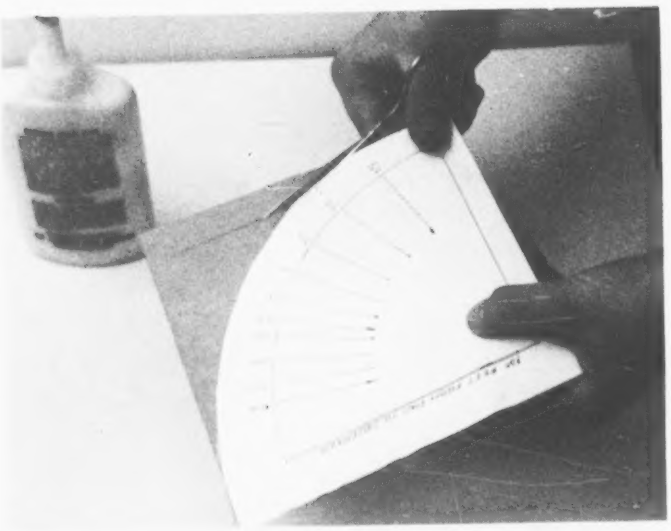


Fig. 4G-15. Trimming Cardboard

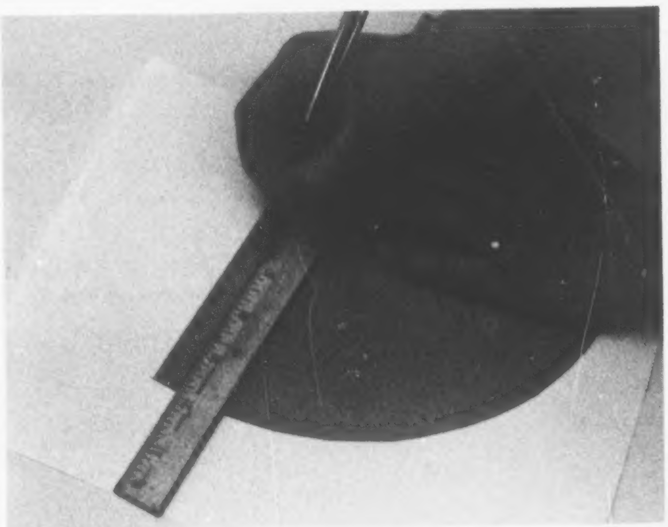


Fig. 4G-16. Line Drawn ½″ from Edge

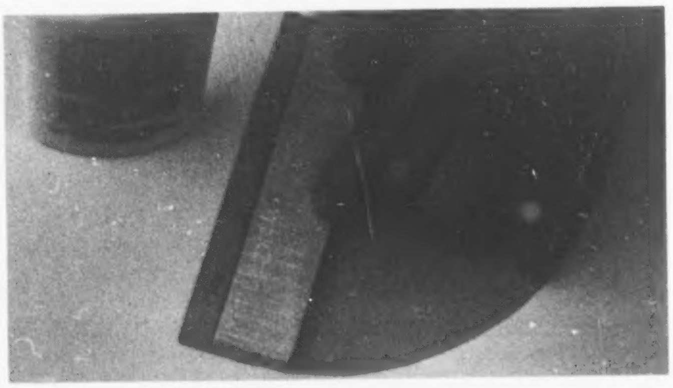


Fig. 4G-17. Wood Strip Glued in Place

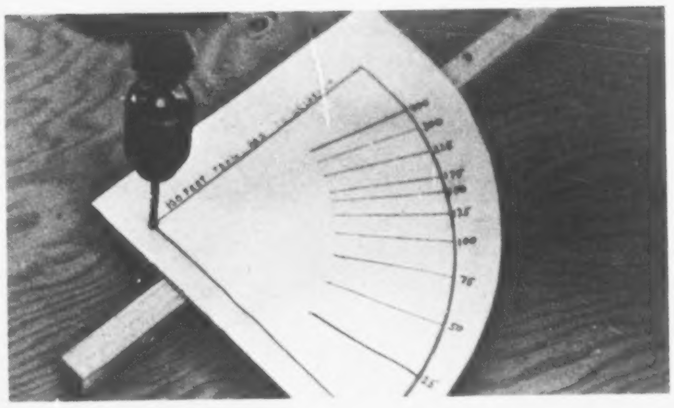


Fig. 4G-18. Drilling Hole in Corner

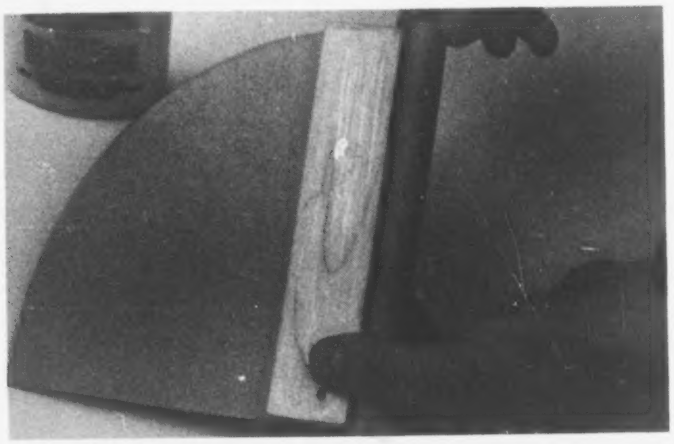


Fig. 4G-19. Gluing Tube to Strip

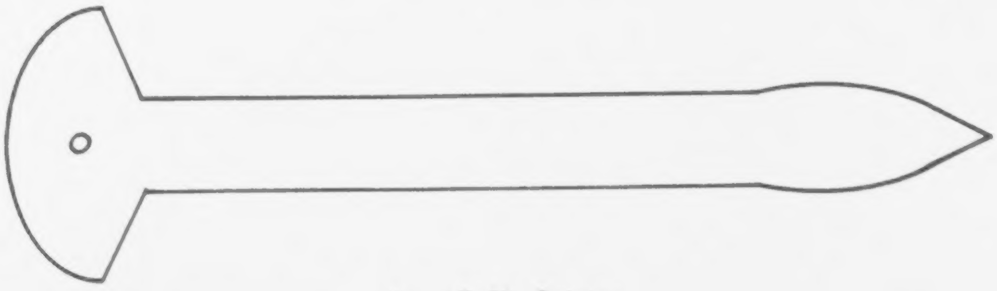


Fig. 4G-20. Pointer

Students 4 and 5
Making Pointers

1. Get one pair scissors, one scriber, one center punch, one ball peen hammer, one 3/16" drill, and a mill file.
2. Cut out a pointer pattern from a Laboratory Manual. See Fig. 4G-20 on page 43.
3. Glue the pattern to a piece of heavy cardboard.
4. Cut out the pattern and cardboard.
5. Using the pattern and a scriber, lay out a pointer for each altitude scope on a piece of 28 gage galvanized iron. See Fig. 4G-21.
6. Center punch the hole location in the pointer.
7. Drill a 3/16" hole at the center-punched location.
8. Cut out the pointer shape with tin snips.
9. File any rough edges on the pointers.
10. Clean up. Return supplies and equipment to storage.

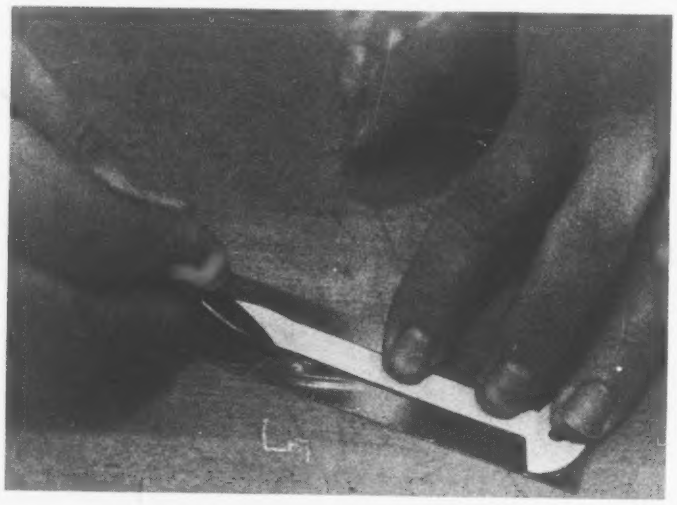


Fig. 4G-21. Scribing around Pointer Pattern

All Students
Assembling Scopes

1. Get one calibrated panel subassembly, one pointer, one 6-32 x 1" screw with nut, and one 6-32 wing nut.
2. Insert the screw through the hole in the pointer and tighten down a hex nut just far enough to allow the pointer to swing freely. See Fig. 4G-22.
3. Insert the screw through the hole in the calibrated panel and tighten in place with a wing nut. See Fig. 4G-23.

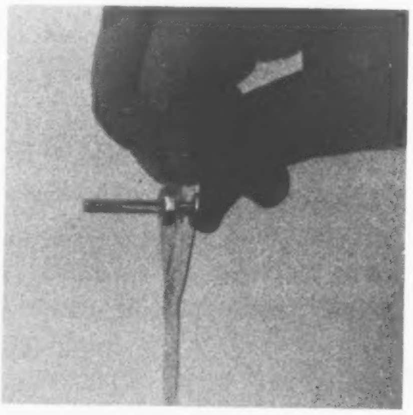


Fig. 4G-22. Nut and Bolt Assembled

Fig. 4G-23. Assembling Scope

4. The pointer should swing freely when the altitude scope is completed. See Fig. 4G-24.

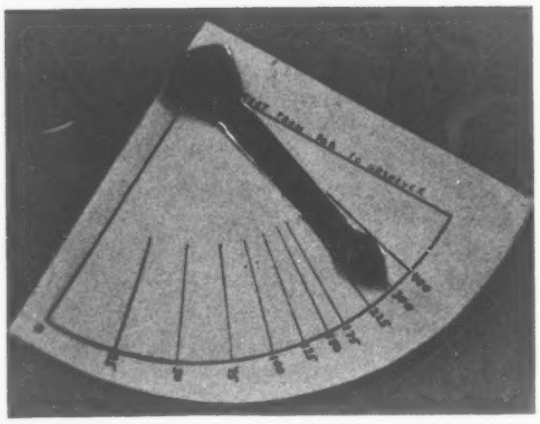


Fig. 4G-24. Completed Scope

Problem 4
Launch Platform

Objective

Using the necessary equipment and supplies, manufacture launch platforms.

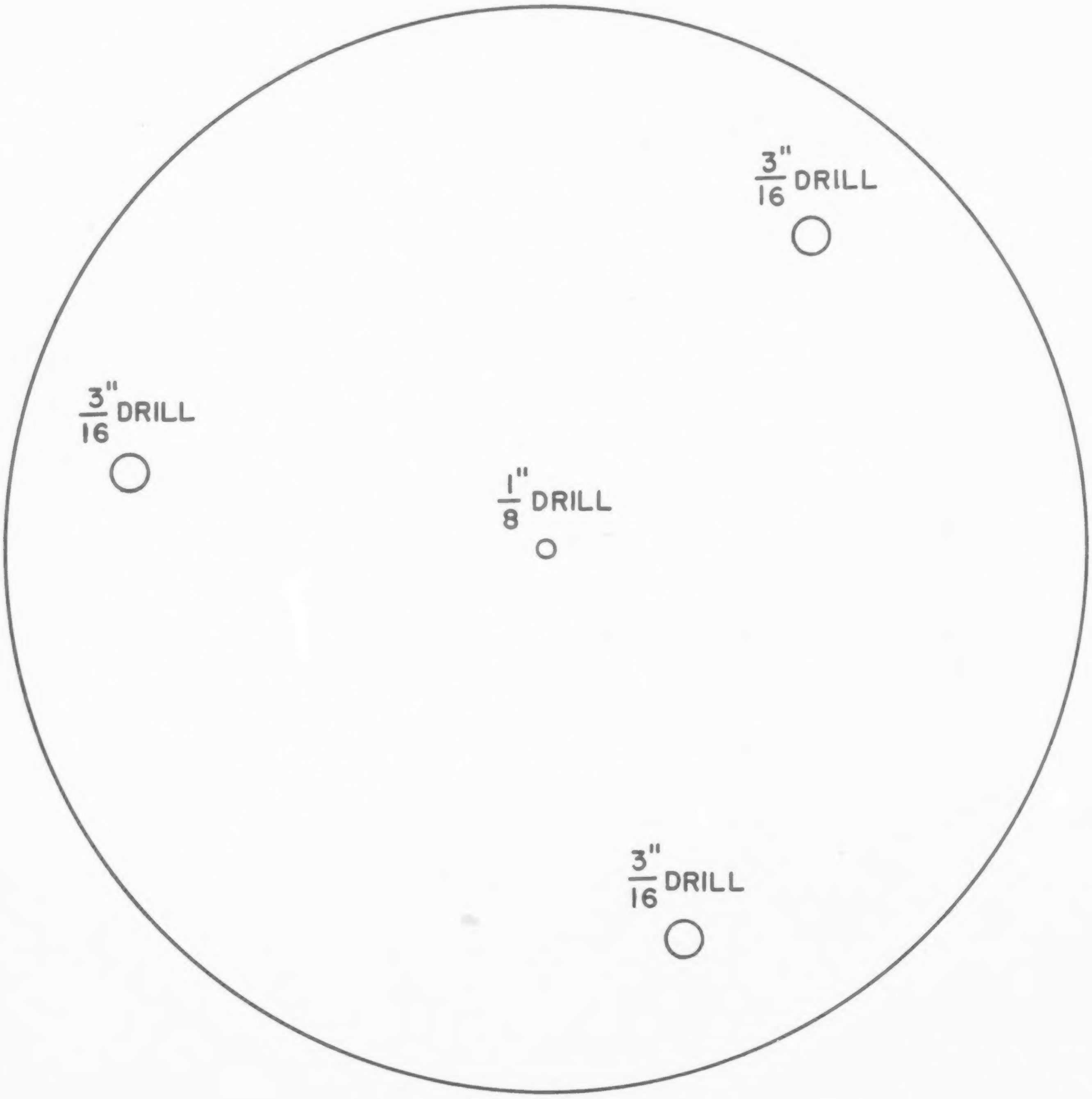

3" / 16 DRILL
3" / 16 DRILL
1" / 8 DRILL
3" / 16 DRILL

Fig. 4G-25. Pattern for the Launch Pad

Equipment (Group of 5)

2 pr.	tin snips
2	mill files
1	ball peen hammer
1	center punch
2 pr.	pliers
2	screwdrivers, 4″

Equipment (Class)

3	6-32 threading dies
3	die stocks
1	drill press
1	⅛″ drill bit

Supplies (Group of 5)

5 pcs.	26 ga. 6″ x 6″ galvanized iron
15	⅛″ x 1″ FH machine screws/nuts
5 pcs.	⅛″ x 24″ welding rod
5	¾″ wood cubes with ⅛″ hole drilled half-way through
1 pc.	6″ x 6″ heavy cardboard
10	6-32 hex nuts

Your teacher will tell you how many launch platforms to make for your group or for the class.

NOTE: Launch pad may be circular *or* square. The important thing is that one ⅛″ hole is in the middle of the sheet metal and the three ⅛″ holes for legs are placed in a circle 120° apart.

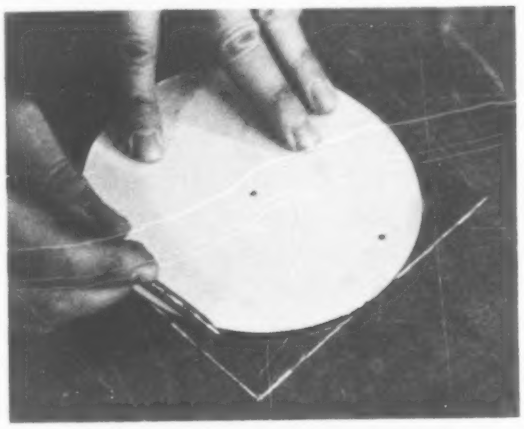


Fig. 4G-26. Scribing around Pattern

Student 1
Making Templates

1. Get the supplies and equipment for your group.
2. Cut out a launch pad pattern from the Laboratory Manual. See Fig. 4G-25, page 45 for template pattern of launch pad. Glue the template to a piece of heavy cardboard and trim the edges.
3. Using the template and a scriber, lay out the circle and hole centers on a piece of sheet metal. See Fig. 4G-26.

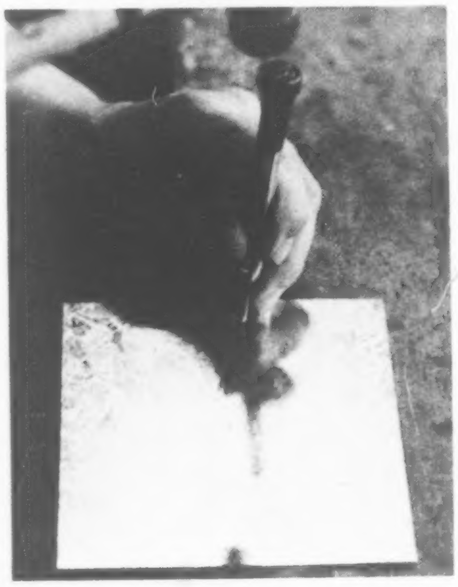


Fig. 4G-27. Center Punching

Student 2
Cutting and Punching

1. Cut out the disk with tin snips.
2. Center punch the hole centers with a center punch and hammer. See. Fig. 4G-27.

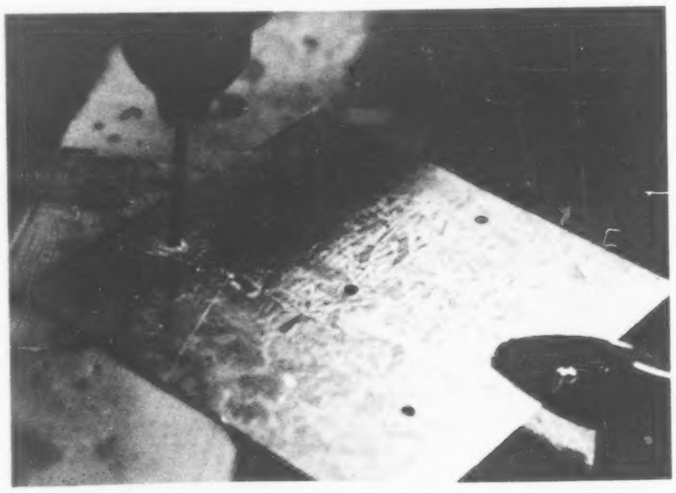


Fig. 4G-28. Drilling Holes

Student 3
Drilling and Filing

1. Drill the four holes with a ⅛″ bit. Hold the disk with pliers and wear goggles while drilling. See Fig. 4G-28.
2. File burrs from holes.

Student 4
Forming

1. *Draw-form* a cup shape for the head of a 1/8" FH bolt. This draw-forming may be done by lightly hammering the head of the bolt (machine screw) inserted in each of the three outside holes located for the feet. See Fig. 4G-29. Hold the metal over a vise that is opened about 1/4", allowing the screw to protrude into the opening while the metal is supported by the vise. Hammer until the screw head is flush with the sheet metal.
2. Install a 1/8" x 1" machine screw in each hole and tighten with a nut and screwdriver. See Fig. 4G-30.
3. File burrs from the ends of a 1/8" by 20" rod. You must wear goggles at all times while working with or handling this rod. Immediately place the safety cube of wood on one end of the rod. See Fig. 4G-31.

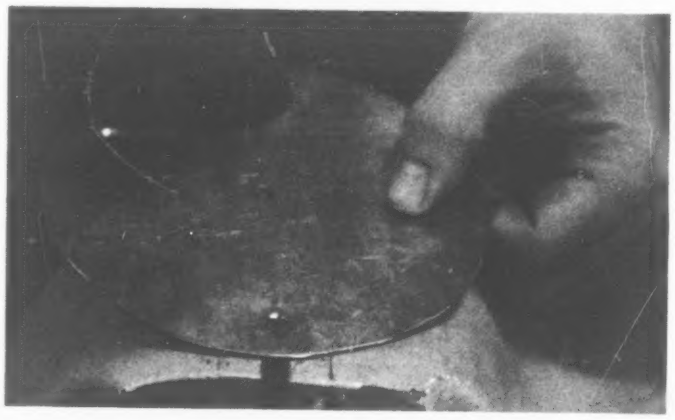


Fig. 4G-29. Forming a Small Recess

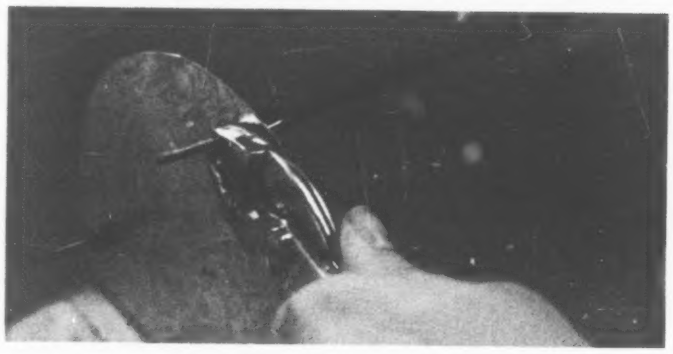


Fig. 4G-30. Installing Machine Screws
Use wrench or pliers.

Student 5
Threading and Assembling

1. Using a 6-32 threading die and die stock, cut threads #6-32 a distance of 1/2" from the other end of the rod. Your teacher will demonstrate the proper method for cutting threads. See Fig. 4G-32.
2. Install the launch rod with two 6-32 nuts. Tighten with pliers. See Fig. 4G-33.
3. Store your launch pad.
4. Clean the work area and return all equipment to designated storage.

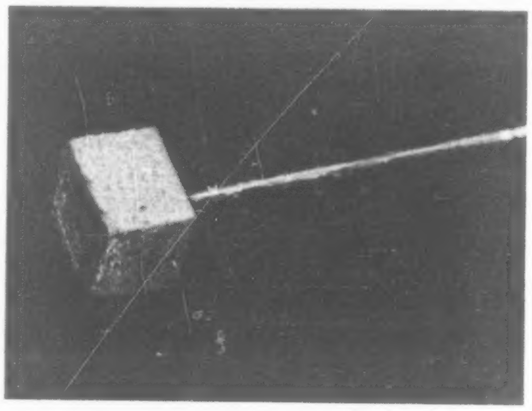


Fig. 4G-31. Safety Cube in Place

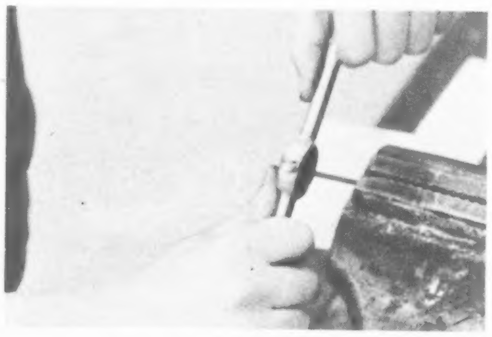


Fig. 4G-32. Cutting Threads

Fig. 4G-33. Assembling Launch Platform

ACTIVITY 5A

Researching and Developing

Today you will *retrieve* information about land speed record assault vehicles.

Problem

Objective

After reading four paragraphs about land speed records, *retrieve* and *record* information.

Retrieving Information

1. You are to work alone.

THE BLUE BIRD

A gas turbine engine was used to power all four wheels of Donald Campbell's record-breaking Blue Bird C.N.7, after nine years of trials, Campbell and the Blue Bird set a new speed record for automobiles of 403+mph., at Lake Eyre, Australia, July 17, 1964. At the time Campbell broke the record, no single official Land Speed Record was recognized by all the racing associations. Craig Breedlove had gone faster in a three-wheeled vehicle, but the old rules of the automobile racing organization (the FIA) admitted only four-wheeled cars. So Campbell held one record and Breedlove held another.

THE GREEN MONSTER

On November 7, 1965, Art Arfons went after a new official Land Speed Record. His Green Monster was powered by a turbojet engine with a four-stage afterburner and had four wheels. The track of the front wheels was 65"; the rear wheel track was 68". On the salt flats of Bonneville, Utah, the Green Monster finished the first of its two timed runs wthout serious trouble. Arfons was putting the vehicle through its official return run when he felt the right side of the Green Monster go down. A tire had blown. Smoke filled the cockpit, and he almost lost control of the car. But luck was with Arfons. The second timed mile was completed before the accident forced the wrenched and twisted vehicle to a stop. The Green Monster's average time for the two runs was 576+ mph., which gave Arfons the official Land Speed Record he was seeking. See Fig. 5A-2.

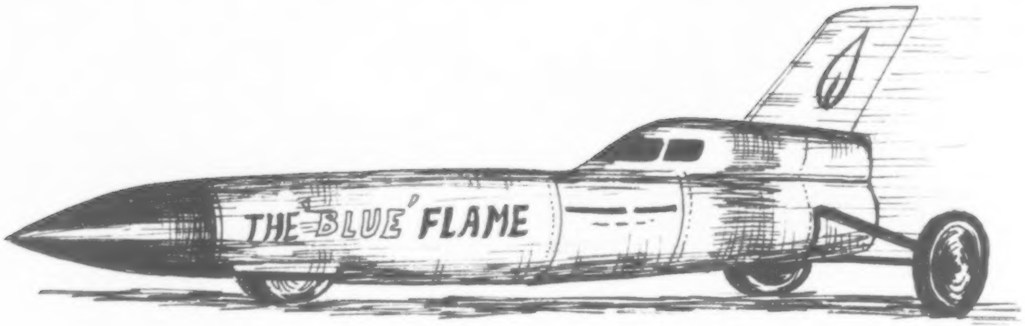
THE SPIRIT OF AMERICA

The Green Monster was the world's fastest land vehicle for only a week. On November 15, 1965, Craig Breedlove's car—shaped like a bottle and pinched in the middle to smooth out airflow—recaptured that honor. The power unit of Breedlove's Spirit of America-Sonic I was a turbojet. Breedlove put his four-wheel vehicle through its two timed runs on a rain-soaked course at Bonneville for an official average time of 600+mph. Breedlove had broken speed records before in a three-wheeled vehicle, but only the motorcycle racing organization (the FIM) gave him official credit for the earlier runs. The 1965 performance of "Sonic I" was an official Land Speed Record. See Fig. 5A-3.

THE BLUE FLAME

Breaking the 600+ speed of the Spirit of America was not an easy task. The above speed record remained on the books until the fall of 1970, when Gary Gabelich broke the land speed record with a two-way average speed of 622.40 mph at Bonneville, Utah. The four-wheel vehicle that Gabelich used to set a new record was powered by a liquid fuel rocket engine. In commenting about the new record, Gabelich explained that on both of his test runs the Blue Flame ran out of fuel about three quarters of the way through the measured mile and actually coasted through the finish. Gabelich plans to come back in 1971 and try and break the sound barrier at 720 mph. using the Blue Flame.

Fig. 5A-1. Information about Speed Records of Racing Vehicles


THE 'BLUE' FLAME

Blue Flame

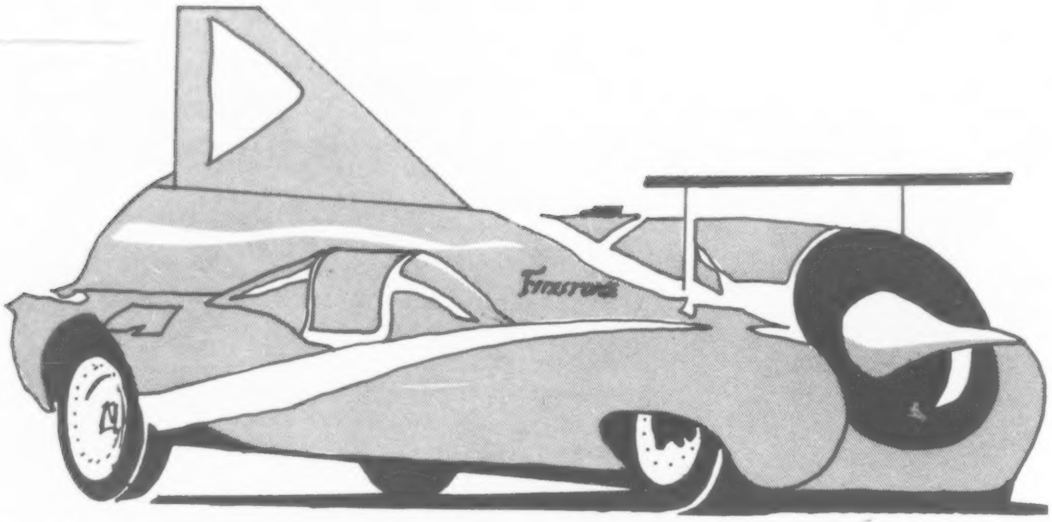


Fig. 5A-2. Art Arfons raises the world land speed record to 576.553 MPH in the jet-powered *Green Monster* in November, 1965, at Bonneville Salt Flats. The new record lasted only eight days.

SPIRIT OF AMERICA
GOOD YEAR

Fig. 5A-3. *Spirit of America* with Craig Breedlove at the controls set a new world land speed record of 600.601 MPH at Bonneville Salt Flats on November 15, 1965.

2. Read the four paragraphs in Fig. 5A-1. They concern land speed record assault vehicles, land speed records, and land speed testing locations.
3. Locate the information asked for in Fig. 5A-4.

Recording

4. Record the information in the appropriate places in Fig. 5A-4.

Fig. 5A-4. Record of Land Speed Data

	Green Monster	Spirit of America Sonic 1	Blue Bird C.N. 7	Blue Flame
Vehicle Speed				
Year Achieved				
Test Location				
Type of Power				
Number of Wheels				
Driver's Name				

ACTIVITY 5B

Researching and Developing

Today you will perform *research by experimenting.*

Problem

Objective

Using the necessary equipment and supplies, conduct an experiment to determine which of three given bearings have the least friction.

Equipment (Class)

1 6′ steel tape
1 friction test track
1 pc. 2″ x 6″ wood, to support track
1 set of 3 test vehicles, as follows:
  Vehicle A, wood serves as bearings
  Vehicle B, soda straw bearings
  Vehicle C, nylon bearings

Preparing for the Experiment

1. The equipment supervisor should see that the necessary equipment is available.

Testing

2. Place Test Vehicle A at starting point and release it.
3. Observe what happens. With chalk, mark the point at which the vehicle's forward motion stops.

Measuring and Recording Results

4. Measure the distance from the reference line to your chalk mark and record this measurement in Fig. 5B-1.
5. Conduct two more test runs for Vehicle A. Measure and record each result. See Fig. 5B-2.
6. Repeat the experiment for Test Vehicles B and C, and record the results.

Fig. 5B-1. Results of Bearing Friction Experiment

	Distances Run by Each Vehicle		
	A Wood Bearing	B Soda Straw Bearing (plastic or paper)	C Nylon Bearing
1st event			
2nd event			
3rd event			
Total Distance ÷ 3	—— 3	—— 3	—— 3
Average			
Best Performance			

7. For each vehicle find an average distance:
   a. Add the three distance figures.
   b. Divide this sum by three. Your answer is the *average.*
8. Decide which vehicle performed best. Check one box at the bottom of Fig. 5B-1 to show this.

Questions

1. The vehicle with the least friction was Vehicle ____ with ________ bearings.
2. Based on this experiment, the best of the three bearing materials is ________.
3. Was this basic or applied research?

   ____

Fig. 5B-2. Conducting Test Runs

ACTIVITY 6

Designing Manufactured Goods

Problem

Objective

Given the problem of *designing* a Land Speed Record Assault Vehicle (LSRAV), select the *design limitations, constants,* and *variables* that influence the design of the vehicle.

Selecting Design Factors

1. Some limitations and constants are shown in Fig. 6-1. Study them.
2. Discuss how all the various *factors* will influence the design of your LSRAV.
3. After considering the various *constants* and *variables*, complete Fig. 6-1 so it specifies *all* the limitations, constants, and variables. *If* there are *no* limitations, constants, or variables, write "None." Fill in all the spaces marked "X."
4. You are now ready to begin to *sketch* your vehicle.

Fig. 6-1. Design Factors

Factors	Limitations	Constants	Variables
Body Limitations			
Length	12″ minimum and maximum	12″	X
Width	1⅝″ maximum	X	X
Height	2¾″ maximum	X	X
Shape	⅜″ min. diameter one full piece	One full piece	X
Axle housing	Axles must be enclosed	1⅝″ minimum width at axles	X
Color	X	May be constant	May be variable
Material	Softwood	Softwood	X
Power Plant Limitations			
Size and material	Metal cartridge	¾″ dia. x 2½″	X
Location	Totally enclosed	Centerline ⅞″ above axle centerline at all points	X
Housing size	⅛″ min. thickness around cartridge	¾″ dia. x 2″	X
Axle, Bearing, Wheel Limitations			
Axle size and material	⅛″ dia. metal rod	⅛″ dia. x 2½″	X
Bearing size and material	X	⅛″ I. D. waxed paper tube	X
Wheel size and material	X	1⅝″ dia. plastic	X
Axle location	Centerline ⅜″ from bottom	Ground clearance	Wheelbase
Steering System Limitations			
Screw eye alignment	X	On centerline	X
Distance between screw eyes	Minimum 6″ apart	X	X

ACTIVITY 7A

Creating Alternate Design Solutions

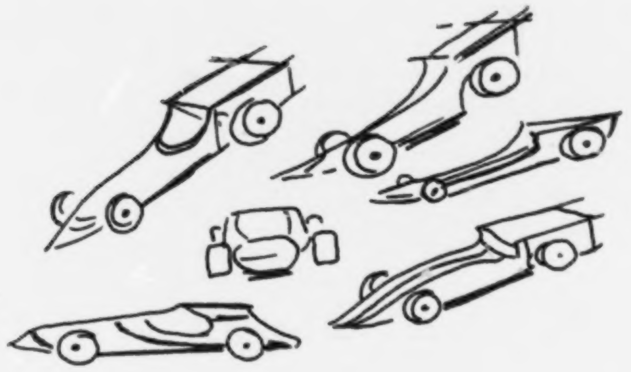


Fig. 7A-1. Thumbnail Sketches

Problem

Objective

Given the problem of *designing* a Land Speed Record Assault Vehicle, make several *thumbnail sketches,* three *roughs,* and a *refined sketch* of the product.

Supplies (Group of 5)

20 shts.	8½″ x 11″ sketch paper
5	colored pencils, felt markers, *or* crayons
1	file folder
5 shts.	carbon paper

Making Thumbnail Sketches

1. The equipment supervisor for your group will obtain the needed supplies.
2. Fig. 7A-1, 2, and 3 show stages in the design of a product. Study them. Do your sketching in a similar way. First make about three simple *thumbnail* sketches of your LSRAV design ideas.
3. You may want to *name* your *LSRAV* and place the name in your sketches.

Sketching Roughs, or Refining Thumbnails

4. From your set of thumbnails, choose one that you think is most promising.
5. The *thumbnail* sketches should now be developed into a *rough* sketch. Sketch each rough on a separate piece of 8½″ x 11″ paper. Remember, a rough is a refined thumbnail sketch. It is developed from your basic idea or a combination

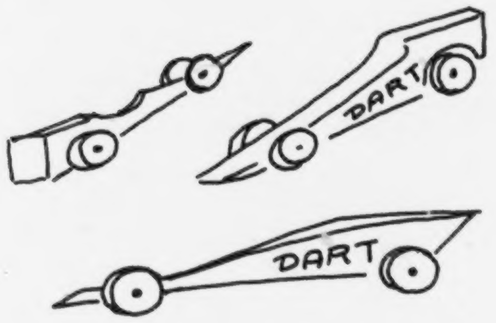


Fig. 7A-2. Roughs

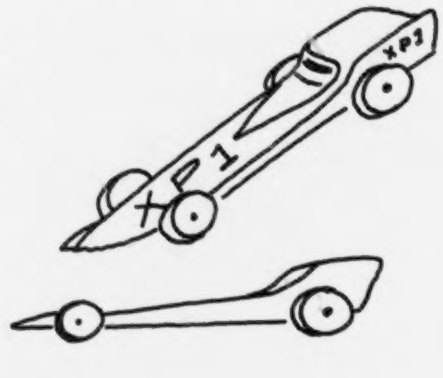


Fig. 7A-3. Finished Sketch

of ideas. Use carbon paper to transfer selected parts of ideas.

Refining Rough Sketches

6. Using your rough sketch, develop it into a refined sketch as follows: Trace it very neatly onto a clean 8½″ x 11″ piece of paper. Make any needed design improvements on the tracing. Then add color.

Certifying

7. Certify by signing your name. *Sign* and *date* your *refined* sketch in the lower right corner.
8. Your recorder will collect and file all sketches, and turn in the file folder.
9. Answer questions 1-4 before putting your Laboratory Manual away.

Questions

1. What do designers call the first sketches made?

   ____

2. A ro__________ sketch is usually developed from a thumbnail sketch.
3. After refining the most promising design from several roughs, or from several alternate designs, what step will the design department take next?

   ____

   ____

4. Why are alternate design solutions developed?

   ____

   ____

   ____

   ____

   ____

ACTIVITY 7B

Creating Alternate Design Solutions

Problem

Objective

Using a *refined sketch* produced in ACTIVITY 7A, develop this sketch into a *full-scale drawing* showing the *front* view and *top* view.

Equipment (Group of 5)

5	pencils
5	12″ rules or straightedges
2	erasers
2	French curves *or* coins

Supplies (Group of 5)

5 shts.	preprinted grid paper
1	file folder with sketches from ACTIVITY 7A

Preparing to Work

1. The equipment supervisor should get the equipment and supplies for everyone in your group. Each student is to work alone.

Drawing

2. Using your refined sketch from ACTIVITY 7A, draw a *front view* of the Land Speed Record Assault Vehicle in outline form, on 1/4″ grid paper. Use French curves or coins to obtain an exact outline on the paper.
3. Draw a *top view* exactly above the front view. See Fig. 7B-1.
   a. Draw axle location.
   b. Draw engine location.
   c. Draw body shape.

Certifying

4. Enter your *name, period,* and *date* on the drawing.
5. Return your drawing to the file folder. The recorder is to return the folder to your teacher.

Questions

1. What is a projection drawing?

____

____

____

2. The top view of a drawing is always placed directly above the front view.

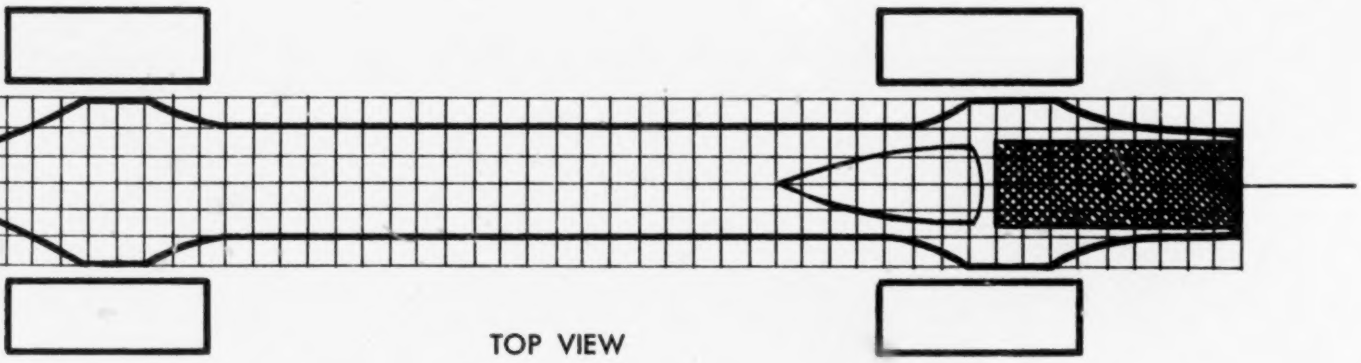
____ True ____ False

3. Where does a designer get the details of shape, size, and dimensions for the mock-ups he will make?

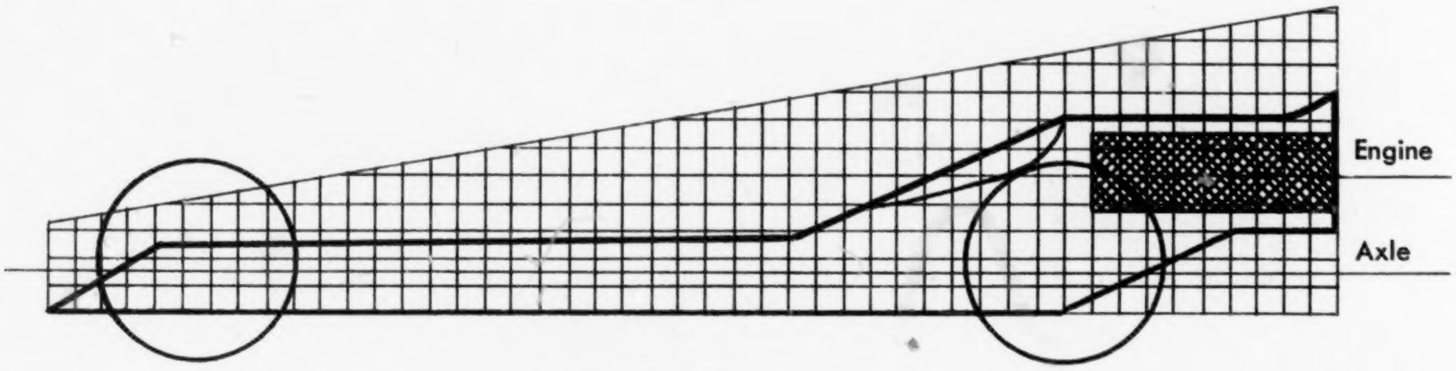
____

____

____



TOP VIEW



FRONT VIEW

Fig. 7B-1. Views of Land Speed Record Assault Vehicle

ACTIVITY 8A

Making Three-Dimensional Models

Problem

Objective

Using the full-scale drawing for a LSRAV from ACTIVITY 7B and the needed equipment and supplies,

a. Make a template for each view.
b. Trace the template onto a block of foamed styrene.
c. Cut the block to shape, making a three-dimensional model.

Equipment (Group of 5)

3	coping saws
3 pr.	scissors
3	ball-point pens
2	X-acto® knives

Supplies (Group of 5)

1 block	2″ x 3½″ x 12″ precut foamed styrene
1 sht.	carbon paper
1	file folder with LSRAV drawing from ACTIVITY 7B
1 pc.	8½″ x 12″ card stock
1 roll	masking tape

Making Templates

1. The equipment supervisor for your group should get the equipment and supplies.
2. Place your drawing, the carbon paper, and the card stock together in proper order. Trace the top and front views of your drawing onto the card stock.
3. Cut out the card stock tracings with scissors. These are templates, or pattern pieces.
4. Tape the front-view template onto the foamed styrene block. See Fig. 8A-1.
5. Trace around the template with a ball-point pen. Then remove the template.
6. Tape the top-view template to the *bottom* of the block. The bottom has a flat surface to make tracing easy. See Fig. 8A-2.
7. Trace around the template with a ball-point pen. Then remove the top-view template.

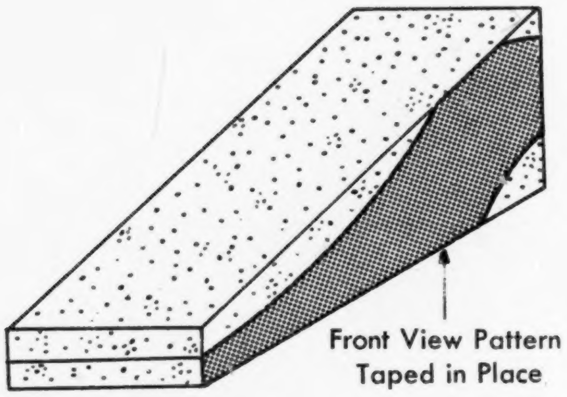


Fig. 8A-1. Front View Pattern Application

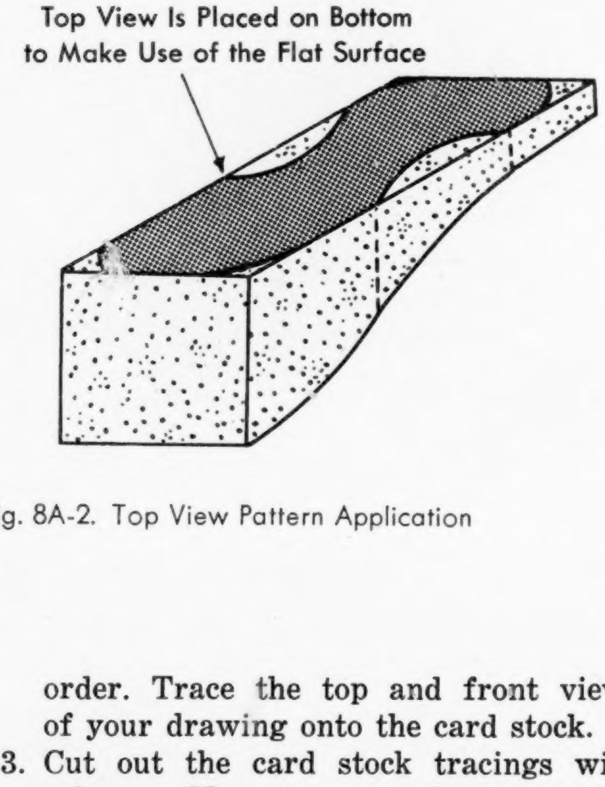


Fig. 8A-2. Top View Pattern Application

Making Mock-Ups

8. Fasten the styrene block *lightly* in a vise. Using the coping saw, saw the *front* view of the LSRAV to shape.
9. Change the position of the block in the vise and saw the top view of the LSRAV to shape.

Safety Precautions

a. Coping saw blades have sharp teeth. Therefore they must be used with caution. Teeth on a coping saw point toward the handle. The saw cuts on the pull stroke.
b. Never force the saw through the material, but allow the teeth to cut through the material.
c. When using a knife, be sure to make all cuts away from yourself.

Cleaning Up

10. File your drawings.
11. Letter your name on the bottom of your 3-D model and store it.
12. Clean up your area, and return equipment.

Questions

1. Name four types of materials you might use in constructing a "paste-up" mock-up.

a. ______________________

b. ______________________

c. ______________________

d. ______________________

2. Give two reasons why "paste-up" mock-ups are made first.

a. ______________________

b. ______________________

3. Name two kinds of products for which designers usually make scale-model mock-ups.

a. ______________________

b. ______________________

4. An appearance mock-up is usually full size and looks just like the final product, but none of its parts will

____

5. A consumer survey often makes use of a mock-up with working parts, called a

____

mock-up.

ACTIVITY 8B

Making Three-Dimensional Models

Problem

Objective

Using the *paste-up* of a land speed record assault vehicle from ACTIVITY 8A and the necessary equipment and supplies, refine the paste-up to an appearance mock-up as a design engineer would.

Equipment (Group of 5)

5	X-acto® knives
2	½″ paint brushes
5	artist's paint brushes, assorted sizes
2 pr.	scissors

Supplies (Group of 5)

20	1⅝″ plastic wheels *or* cut wheels from styrofoam with ⅛″ axle holes
10 pcs.	⅛″ x 2½″ welding rod (for axles) *or* heavy coat hanger wire
5 btls.	tempera (water) paints, assorted colors, 2 oz. bottles
1 roll	masking tape
5 shts.	8½″ x 11″ construction paper, assorted colors
1	file folder from ACTIVITY 8A
5	LSRAV
1 btl.	white glue for repair

Preparing to Work

1. The equipment supervisor for your group should get the needed equipment and supplies.
2. Cover your work area with newspapers to prevent damage to the work surface.
3. In your group's folder find your sketch showing ideas for painting or trimming the LSRAV.

Safety

a. When you carve foamed styrene with a knife, the blade should always be directed away from your hand.
b. When you paint your mock-up, be sure to keep the work area clean.

Constructing the Appearance Mock-Up

4. Carve your paste-up to look like your refined sketch.
5. Sand, color, and decorate your paste-up.
6. Push the welding rod axles through the foamed styrene.
7. Force the wheels onto the axles.

Cleaning Up

8. On signal from the timekeeper, clean up the work area and put away equipment and supplies.
9. Each equipment supervisor should return his group's completed mock-ups to storage.
10. Each recorder should return his group's drawing to the file folder and return the folder to storage.
11. Each student should answer questions 1-3.

Questions

1. How is a paste-up different from an appearance mock-up?

____

____

____

____

2. Hard mock-ups may serve as patterns for making ______________ and ______________ for the product.
3. How is a hard mock-up different from the product?

____

____

ACTIVITY 9

Refining the Design Solution

Problem

Objective

Using the appearance mock-ups from ACTIVITY 8B, modify and refine the design solution into its final form.

Equipment (Group of 5)

5	X-acto® knives
2	½″ paint brushes
5	artist's paint brushes, assorted sizes
2 pr.	scissors

Supplies (Group of 5)

5	paper towels
5 btls.	tempera paints, 2 oz. bottles, assorted colors
5 shts.	8½″ x 11″ construction paper, assorted colors
1	file folder from ACTIVITY 8B
5	LSRAV appearance mock-ups from ACTIVITY 8B

Preparing to Work

1. Meet with your group and have the equipment supervisor obtain the needed equipment and supplies.

Safety

a. Always direct the knife blade away from your hand when carving.
b. Protect the work area from paint.

Refining the Design Solution

2. First decide what changes need to be made. Then shape, color, and decorate your appearance mock-up into its final form.

Cleaning Up

3. On a signal from the timekeeper, clean up the work area and put away the equipment and supplies.
4. Each equipment supervisor should return the completed mock-ups to storage.
5. Each recorder should return the file folder to storage.

Questions

1. Name two factors that could produce a change in the design solution.

   a. ______________________________

   b. ______________________________

2. What changes did you make when you refined your appearance mock-up?

   ____

   ____

3. Why did you make these changes?

   ____

   ____

   ____

ACTIVITY 10

Engineering the Product

Problem

Objective

Given four bearings with inside diameters of various sizes, and an axle rod,

a. Attempt to fit each bearing on the axle.
b. Measure the inside diameter of each bearing to the nearest 1⁄16″.
c. Measure the diameter of the axle to the nearest 1⁄16″.
d. Measure *clearances*.
e. Record all measurements and *analyze* the *data*.

Equipment

1	¾″ dia. x 12″ dowel rod (axle)
4	washers (bearings), graduated sizes ⅝″, ¾″, ⅞″, and 1″ I.D.
1 pr.	inside calipers
1 pr.	outside calipers
1	12″ rule, with 16ths marked

Fig. 10-1. Clearance Data Chart

	Washers			
	A	B	C	D
1. Does bearing fit on axle?				
2. Measured I.D. of bearings				
3. Measured O.D. of axle rod				
4. Clearance between bearing and axle				

Preparing to Work

1. Meet with your group. The equipment supervisor will get the needed equipment.
2. Arrange the set of washers (bearings) on the workbench according to the inside diameter size. The smallest will be *A*, the next larger *B*, etc.

Testing and Recording

3. One student is to test bearing A by trying to fit it onto the axle.
4. The group's recorder is to enter the results of the test in Fig. 10-1, Clearance Data Chart, Row 1.
5. Repeat Steps 3 and 4 for bearings B, C, and D. Students should take turns in this task.

Measuring and Recording

6. Two students are to measure the inside diameter of each bearing to the nearest 1⁄16″, using inside calipers and a rule.
7. The recorder is to enter these data in Fig. 10-1, Row 2.
8. Two students are to measure the outside diameter of the axle to the nearest 1⁄16″, using outside calipers and a rule.
9. This measurement is to be entered in Fig. 10-1, Row 3.
10. When a bearing is fitted onto an axle, the free space between them is the *clearance*. Two students are to measure the clearance for each bearing that will fit on the axle. See Fig. 10-2.
11. Record the clearance in Fig. 10-1, Row 4.
12. Each student, except the recorder, is to copy the data onto Fig. 10-1 in his Laboratory Manual.

Verifying

13. The recorder is to verify some or all of the data, by remeasuring, while the other students copy data.

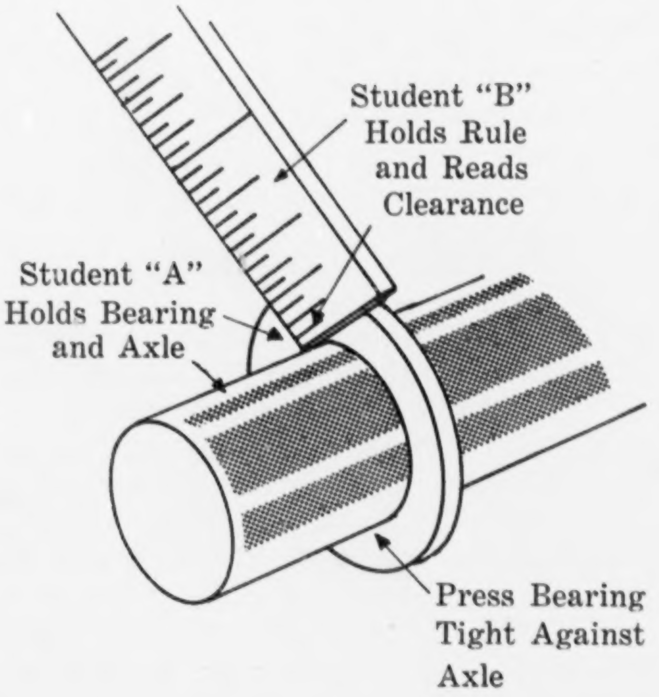

Student "B"
Holds Rule
and Reads
Clearance
Student "A"
Holds Bearing
and Axle
Press Bearing
Tight Against
Axle

Fig. 10-2. Measuring Clearance between Bearing and Axle

Questions

1. Which bearing fit very tight or did not go on at all?

   ____

2. Which bearing slipped on and off most easily?

   ____________ and ____________

3. What were the clearances for these bearings? ____________ and ____________

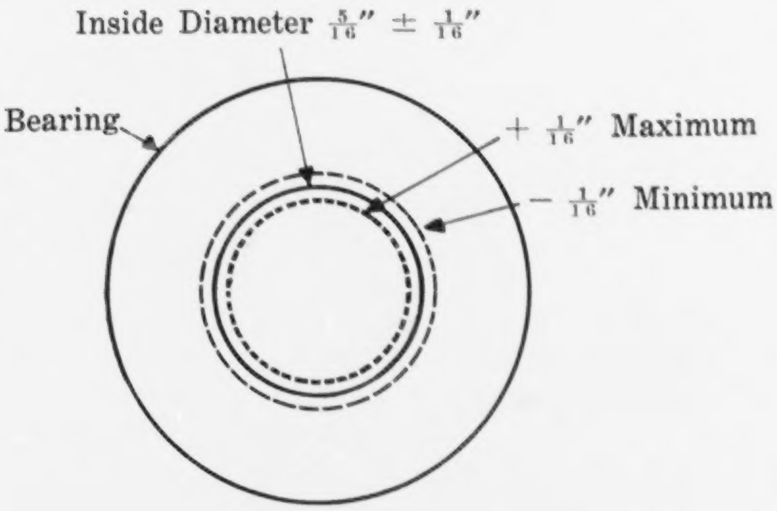

Inside Diameter 5/16" ± 1/16"
Bearing
+ 1/16" Maximum
− 1/16" Minimum

Fig. 10-3. Bearing, with Maximum and Minimum Tolerance Shown

4. Suppose that an engineer has decided these will be the *minimum* (smallest) and the *maximum* (largest) acceptable clearances for a bearing and axle assembly. If the axle is always exactly ¾" in diameter, the smallest acceptable bearing diameter will be ____________

   and the largest will be ____________.

5. These two limits on bearing size will establish the *tolerance* permitted for bearings. Study Fig. 10-3. Will the tolerances shown match the needs given in Question 4?

   ____

ACTIVITY 11

Designing Power Elements

Problem 1

Objective

Given the problem of determining the *thrust* of a CO_2 cartridge in a LSRAV,

a. Fire the LSRAV against a postage scale.
b. Record and plot the findings.

Equipment (Group of 5)

1	postal scale
5	CO_2 cartridges
1	CO_2 cartridge-firing mechanism

Preparing to Work

1. Get the materials for your group.
2. Place a postage scale on its back so the dial is up and the base is against a wall, step, or cinder block on the table. See Fig. 11-1.
3. Put the LSRAV against the scale and insert a CO_2 cartridge.
4. Place Laboratory Manuals next to each side of the car so that the car will run freely between them. See Fig. 11-1.
5. Hold the car and fire the CO_2 cartridge.
6. Immediately after firing, let go of the car and read the thrust on the scale in ounces. Record the thrust in Fig. 11-2.
7. Repeat the firing two more times with the same car. Add all the thrust measurements and divide the sum by the number of firings to find the average thrust. See Fig. 11-2.
8. Weigh the car on the scale with the CO_2 cartridge in place.
9. Record the weight and average thrust of the car in Fig. 11-3.

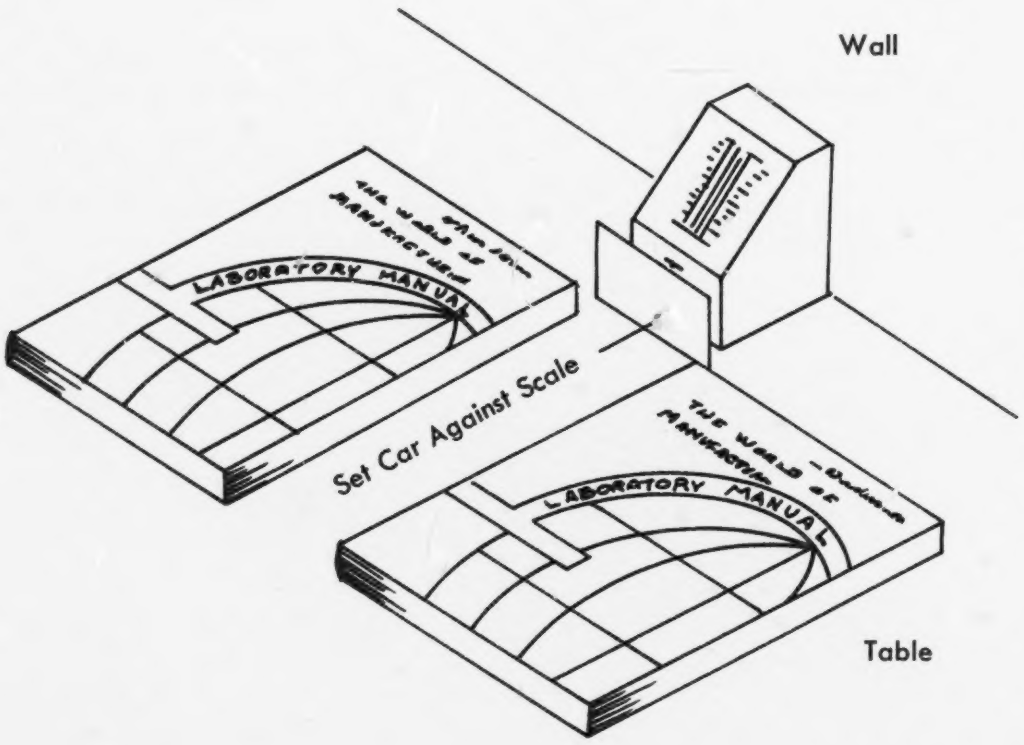


Fig. 11-1. Firing Test Setup

Test No.	Thrust
Firing 1	oz.
Firing 2	oz.
Firing 3	oz.
Total	oz.
Average (Total ÷ 4)	oz.

Fig. 11-2. Thrust Data

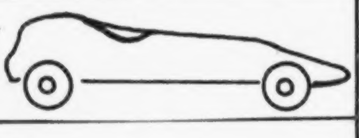
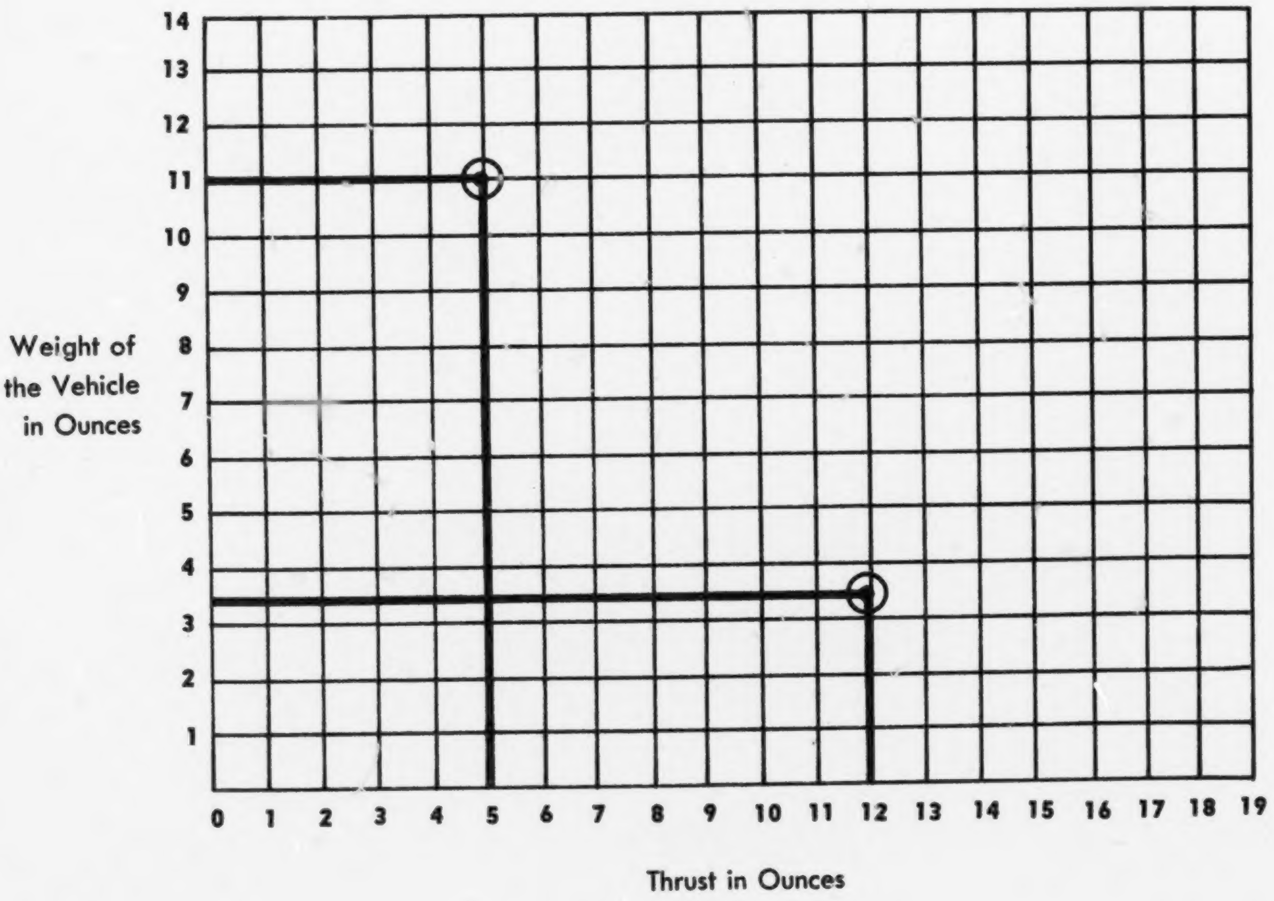
Car	Weight of Car	Average Thrust
1. 	11oz.	5oz.
2.		
3.	3.5oz.	12oz.

Fig. 11-3. Weight and Average Thrust Data for Group Car

Fig. 11-4. Thrust Projection Graph



Problem 2

Objective

Given the problem of drawing a graph which represents the weight and thrust of different LSRAV's,

a. Collect the findings of each group's test.
b. Plot the findings on a graph.

1. Near the end of the class period your teacher will call for your findings.
2. The recorder in each group will announce the weight of the LSRAV tested and the average thrust of the vehicle.
3. Plot these findings on Fig. 11-4.
4. By connecting these points you will have made a graph that will predict the thrust of the LSRAV that you will soon build, based on the weight of your LSRAV.

ACTIVITY 12A

Making Working Drawings

Problem

Objective

Based on the engineering requirements developed in ACTIVITIES 10 and 11, draft a set of *working drawings* for a model LSRAV.

Equipment (Group of 5)

5	12″ rules

Supplies (Group of 5)

5 copies	drawing of LSRAV basic form, full scale
10 pcs.	8½″ x 14″ tracing paper *or* tape two 8½″ x 11″ sheets together
20	paper clips
1	file folder, from ACTIVITIES 10 and 11

Making Working Drawings

1. Equipment supervisor get the equipment, supplies, and file folder containing your work.
2. You have already made sketches of your LSRAV showing the basic form and limitations on Drawing No. 100. See Fig. 12 A-2.
3. Today you will *sketch* the *front* and *top* view of your LSRAV from your first sketch (Drawing 100).
4. Check your Drawing 100 and make any necessary corrections of the shape or form.

Drawing the Body

5. *Darken the lines* after you are sure that you have the shape and form drawn to the size you want.
6. Fasten a piece of tracing paper over the sketch, using paper clips. Carefully trace your sketch, using a straightedge to guide your pencil. Do not show dimensions.
7. Repeat Step 6, using *another* piece of tracing paper.
8. Enter the title "LSRAV DETAILS" on Drawing No. 101 on the first tracing. Enter the title "LSRAV ASSEMBLY" and "DWG. No. 102" on the second tracing. Also enter your name on each tracing. See Figs. 12A-1 and 12A-2.
9. Equipment supervisor file all drawings and return them with the equipment to your teacher.

Questions

1. A drawing that includes several views of a product, with all the parts assembled or put together, is called a

   ______________________________ drawing.
2. The exact distance between two points on a part is called a

   ____
3. On a drawing the arrow, numeral, and extension lines that give information about a distance also are called a

   ____
4. A drawing that shows how the parts of an electrical or hydraulic system work together is called a schematic or

   ____________________ drawing.
5. A drawing that shows two or more sides of an object in one view is called a

   ____________________ drawing.

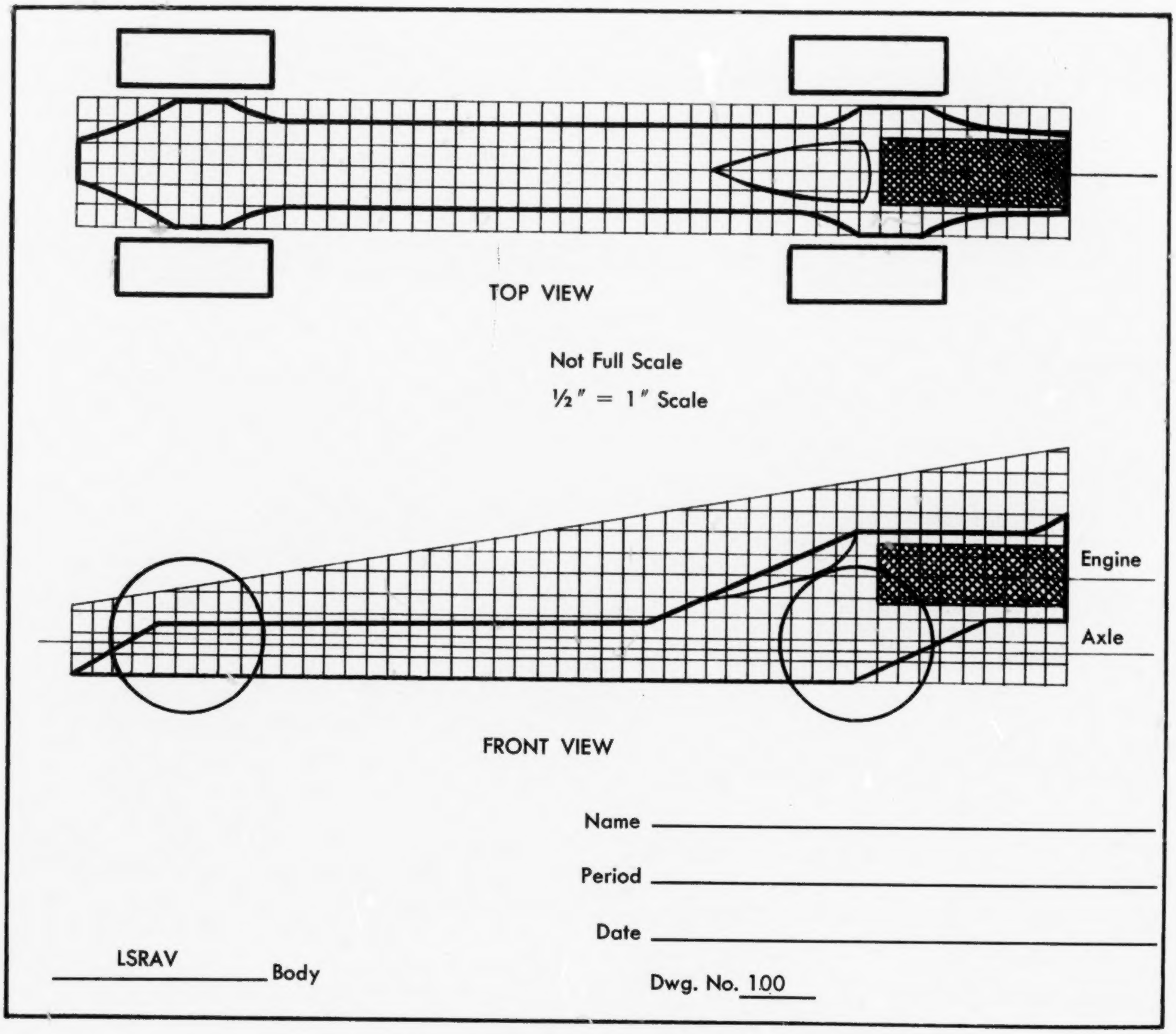

TOP VIEW
Not Full Scale
½" = 1" Scale
Engine
Axle
FRONT VIEW
Name
Period
Date
LSRAV
Body
Dwg. No. 100

Fig. 12A-1. Front and Top Views of LSRAV (Example only)

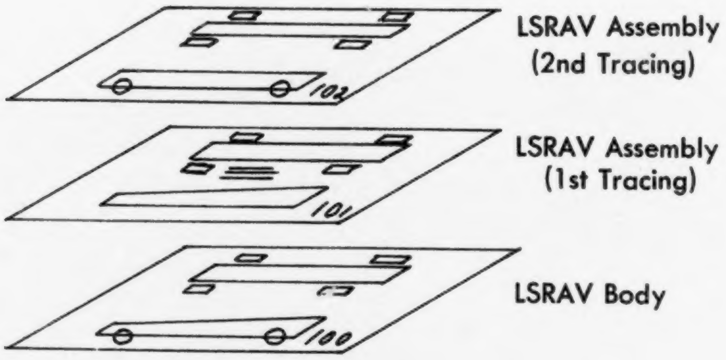
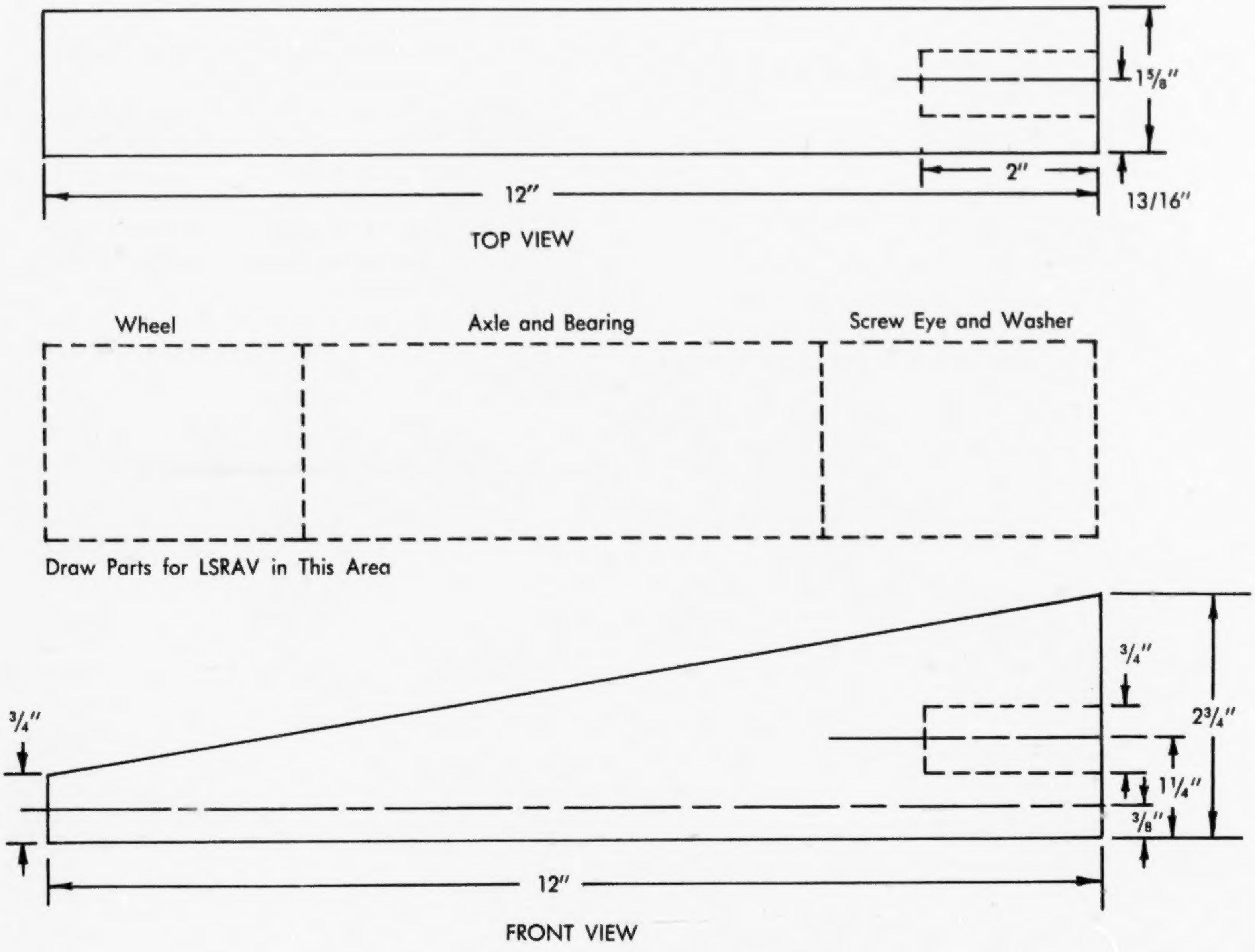

LSRAV Assembly
(2nd Tracing)
102
LSRAV Assembly
(1st Tracing)
101
LSRAV Body
100

Fig. 12A-2. LSRAV Drawings


1⅝″
2″
12″
13/16″
TOP VIEW
Wheel
Axle and Bearing
Screw Eye and Washer
¾″
¾″
2¾″
1¼″
⅜″
12″
FRONT VIEW

Draw Parts for LSRAV in This Area

LSRAV Body

Name ____________________

Period ____________________

Date ____________________

Dwg. No. ____________________

Fig. 12B-1. Dimensions of LSRAV

ACTIVITY 12B

Making Working Drawings

Problem

Objective

Using the LSRAV drawings started in ACTIVITY 12A,

a. Make *detail drawings* of the vehicle's wheel, axle, bearing, screw eyes, and washers.

b. Prepare an assembly *working drawing* by adding parts to the LSRAV body.

Equipment (Group of 5)

5 12″ rules

Supplies

1 file folder from ACTIVITY 12A
5 pcs. 8½″ x 14″ tracing paper
20 paper clips

Showing Details

1. Equipment supervisor get your equipment and supplies.
2. Take out your drawings from ACTIVITY 12A. Use a pencil on all work.
3. On Drawing 101, lightly sketch the additional parts of the LSRAV model in the open space between the front and top views. Read the dimensions shown in Figs. 12B-1 and 12B-2, and prepare your sketch to conform with them. Draw full scale front views only.
4. Carefully check your sketch with other members of your group. Make any needed corrections.
5. When you are sure your sketch is correct, *darken* the object lines.
6. Place Drawing 102 over Drawing 101 and sketch today's additions onto the drawing, using a straightedge to guide your pencil. Move the paper around to line up the location of the parts. Trace the parts in their proper location to make an assembly drawing.
7. Clip the drawings together and file them.
8. Return the rule and extra paper clips.

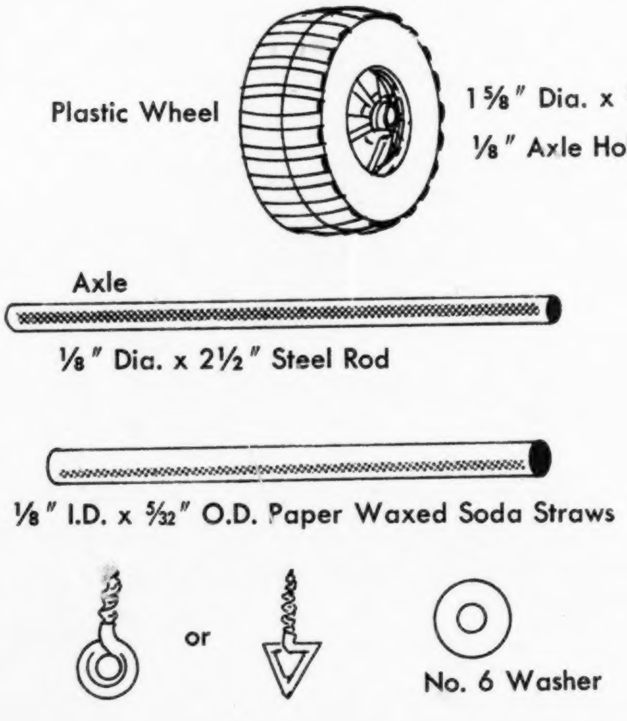

Plastic Wheel
1 5/8″ Dia. x 3/4″
1/8″ Axle Hole
Axle
1/8″ Dia. x 2 1/2″ Steel Rod
1/8″ I.D. x 5/32″ O.D. Paper Waxed Soda Straws
or
No. 6 Washer

Fig. 12B-2. Wheel, Axle, and Bearing for LSRAV
These parts are to be drawn separately on Drawing 101 to make detail drawings.

ACTIVITY 12C

Making Working Drawings

Problem 1

Objective

Given the working drawings made in ACTIVITIES 12A and 12B, enter dimensions and notes on all drawings.

Equipment (Group of 5)
5 12″ rules

Supplies (Group of 5)
1 file folder from ACTIVITY 12A

Dimensioning Drawings

1. Equipment supervisor get your equipment and supplies and remove your set of drawings.
2. You may wish to practice your dimensioning on Drawing No. 100.
3. Add all *dimensions* to Drawings 101 and 102. Refer to Figs. 12B-1 and 12B-2 for guidance.
4. *Be sure* to include for each dimension a numeral, a dimension line, and arrowheads. Also put in extension lines wherever they are needed.
5. After you have entered all the dimensions on your drawings, *add any notes* that will explain details not shown by the dimensions.
6. Number *each* part. Show part numbers on all drawings.

Checking for Completeness and Accuracy

7. Check your drawings for *name, date,* and *drawing number.* Check Drawings 100, 101, and 102 for *labeling* of parts.
8. Have another member of your group check your drawings for completeness and correctness. Have him initial the drawings beneath your name if they are correct.

Problem 2

Objective

Using the working drawings from ACTIVITIES 12A and 12B, prepare a *parts list for all items* shown in the drawings.

Equipment (Group of 5)
5 12″ rules

Supplies (Group of 5)
1 file folder from ACTIVITY 12A
5 pcs. 8½″ x 11″ unlined paper

Making the Parts List

1. On a sheet of *plain paper,* draw and label a form to look like Fig. 12C-1. Rule enough lines to list *all* the parts.
2. Record the *name* of the product (LSRAV) and the *drawing number.*
3. In the "Part No." column, enter the numbers of *all* parts of the LSRAV. Begin with the *body.* Refer to your drawings for the other part numbers. See Fig. 12B 2 for some items to list.
4. Under "Description" enter the part name to which each number refers.
5. "Quantity Required" means the number of pieces required or needed. Enter the appropriate number for each part.
6. Enter *fir* in the "Material" column where applicable. Enter other materials such as *steel, plastic* or *rubber* in the other spaces where applicable.
7. Place a check mark under "To Be Purchased" if the part is one which *cannot easily be made* in your class. For the parts that *could be made,* leave this space blank.

8. *Sign and date the Parts List in the lower right-hand corner.* Paper-clip it together with your set of working drawings.

Cleaning Up

9. File your drawings. Clean up the work area and return equipment.

Fig. 12C-1. Form for Listing Parts

PARTS LIST

Product:________________ DWG. No________

Part No.	Name of Part	Material	Qty. Reqd.	To Be Purchased?
3	Example: Screw Eye	Brass	2	Yes

ACTIVITY 13A, B, C, and D

Building the Production Prototype

During these activities you will fabricate and assemble a production prototype of your design for a land speed record assault vehicle. You will have three activity periods in which to complete your prototype.

Problem

Objective

Given the necessary supplies and equipment, fabricate and assemble a production prototype according to a set of working drawings.

Equipment (Class)

1	bandsaw
1	drill press
1	Drill Fixture 31-3
2	C-clamps
1	¾" spade bit

Equipment (Group of 5)

5 sets	working drawings
1	half round wood rasp
1	half round cabinet file
1	3/16" twist drill
1	scratch awl
1	ball peen hammer
1	utility knife
1 pr.	pliers, side cutting

Supplies (Group of 5)

5	vehicle kits
5 shts.	carbon paper, 4¼" x 14"
5 shts.	abrasive paper, medium
5 shts.	abrasive paper, fine
1 can	spray paint, white
1 set	felt tip markers
10	thumb tacks

Preparing to Work

1. Get the necessary equipment and supplies and assemble at your work station.
2. Using the drill press and drill fixture, bore a ¾" hole in each end of the 2" x 4" as demonstrated by the teacher. See Fig. 13A-1. Then give the 2" x 4" to the teacher for sawing.

Safety

a. Keep fingers away from cutting edges of the drill.
b. Wear safety glasses when drilling.

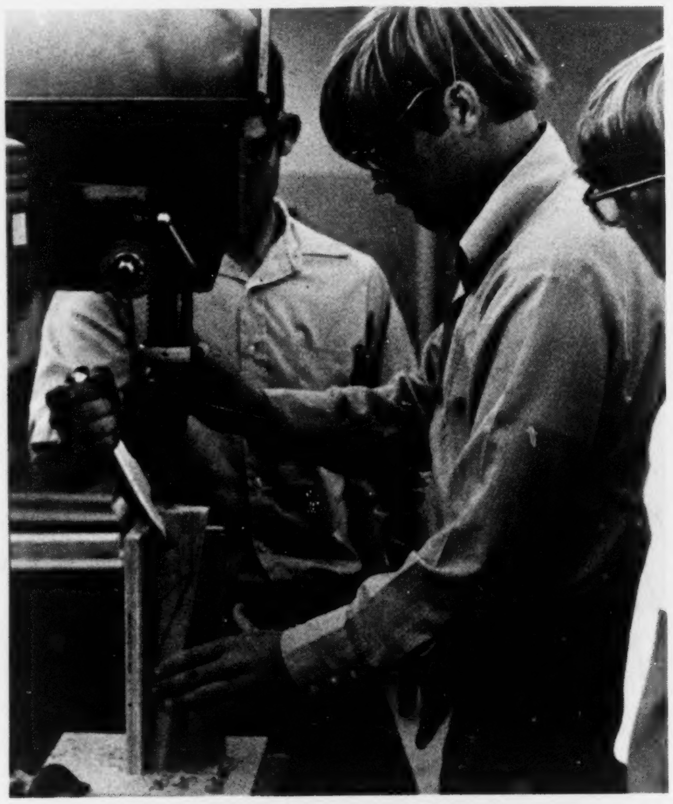


Fig. 13A-1. Boring ¾" Engine Hole 2" Deep
Drill holes directly opposite each other in both ends of a 2 x 4.

Layout

3. Transfer the front view from the working drawing to the block of wood. Use thumbtacks to hold the drawing and carbon paper securely. Be sure to mark axle locations.

Drilling

4. Using the drill press and Drill Fixture 27-3, drill axle housings as follows:
   a. Insert wood into fixture so that it touches the stop. Align to proper location and drill the first axle housing. See Fig. 13A-2.
   b. Realign and drill the other axle housing.

Sawing

5. Using the bandsaw, cut the front view of the body to shape.

Shaping

6. Shape the top view, using a wood rasp and a file.
7. Smooth the body by sanding; first use medium abrasive paper, then fine abrasive paper.

Coating

8. Give the body two coats of spray paint. Allow for drying time between coats.
9. If you wish to decorate the body, use felt tip markers.

Assembling

(See Fig. 13A-3.)

10. Cut and install the soda straw bearings.
11. Cut and install the axles.
12. Place washers in position.
13. Wheels are now forced on axles.
14. Be certain wheels are securely attached to axles, and that axles turn freely.
15. Using a scratch awl, make a small hole on the bottom, close to each end. Use pliers to insert the screw eyes and tighten. Ask your teacher for the exact location of the screw eyes. Make sure that you have proper ground clearance.
16. Store your prototype as your teacher instructs you. Be sure your name is on the bottom.

Cleaning Up

17. Clean the area and return all tools to storage.

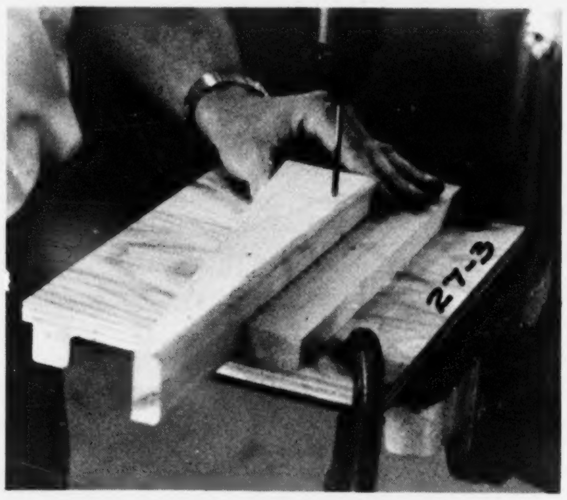


Fig. 13A-2. Drilling Axle Housings

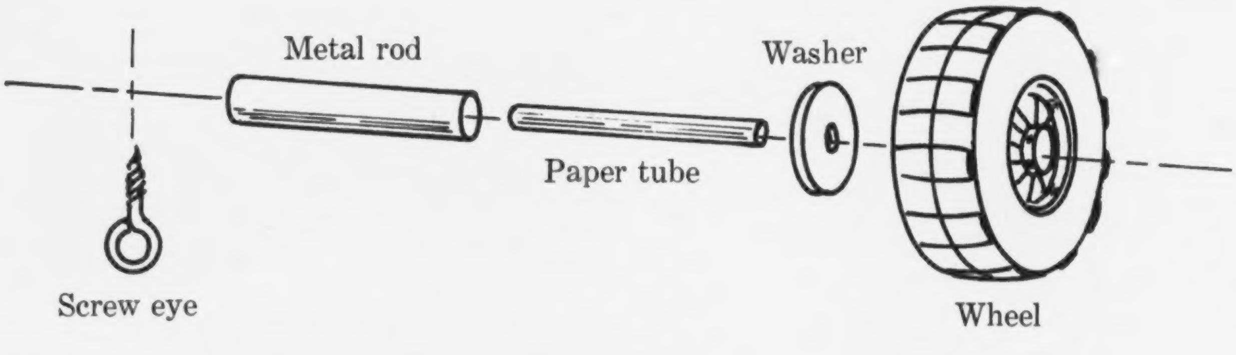


Fig. 13A-3. Assembly View

Fig. 13E-1. Table for Changing Vehicle Speed to Scaled Miles Per Hour

1	2		3		4	
Time in Seconds	Scaled Speed for 3 Track Lengths					
	40 ft. Track Number of MPH		50 ft. Track Number of MPH		60 ft. Track Number of MPH	
STUDENT NOTE: Divide by 12 to Find Actual Miles Per Hour						
	Scaled	**Actual**	**Scaled**	**Actual**	**Scaled**	**Actual**
.7	932		1,165		1,398	
.8	816		1,020		1,224	
.9	725		906		1,087	
1.0	652		816		979	
1.1	593		741		890	
1.2	543		679		816	
1.3	502		627		753	
1.4	466		582		699	
1.5	435		543		652	
1.6	408		510		612	
1.7	383		479		575	
1.8	362		453		543	
1.9	343		429		515	
2.0	326		408		489	
2.1	310		388		466	
2.2	296		370		445	
2.3	283		354		425	
2.4	271		339		408	
2.5	261		326		391	
2.6	251		313		376	
2.7	241		302		362	
2.8	233		291		349	
2.9	225		281		337	
3.0	217		271		326	

ACTIVITY 13E, F

Building the Production Prototype

Today you will *test and certify the performance of your prototype vehicle.*

Performance Record for
Land Speed Record Assault Vehicle

Date ______________________

Distance ______________________ Feet

Time ______________________ Seconds

Weight with Engine ______________________ Oz.

Scaled Speed ______________________ MPH

Actual Speed ______________________ MPH

This prototype vehicle has met all requirements for certification of performance.

Signed ______________________
Test Engineer

Fig. 13E-2. Certificate of Performance

Problem

Objective

Using a production prototype, *test the performance by timing* a test run and calculating speed.

Equipment (Class)
1 start/finish gates with tether lines
1 stopwatch
1 postal scale, calibrated in ounces

Supplies (Student)
1 prototype vehicle
1 CO_2 cartridge

Testing Performance

1. Get your vehicle.
2. Conduct a test run, following your teacher's instructions. Time it accurately and record the time here:

   ________ seconds
3. After your vehicle has completed its test run, find the *scaled* speed for a full-sized vehicle from Fig. 13E-1, as follows:
   a. In Column 1, find and mark the entry that shows the *Trial Time* for your LSRAV.
   b. Choose Column 2, 3, or 4, according to the *length* of your test tract (40′, 50′, or 60′).
   c. For your Trial Time, find and mark the *speed* in Column 2, 3, or 4.
   d. To find the actual speed, divide the scaled speed by 12.

Certifying Performance

4. Complete Fig. 13E-2, Certificate of Performance, by signing it *yourself.*
5. All equipment and supplies are to be returned to storage.

ACTIVITY 14

Technical Writing and Illustrating

You are to complete Problem 1 by yourself. Your group will discuss Problem 2 before completing it.

Problem 1

Objective

Using an exploded pictorial drawing of an LSRAV and data:

a. Prepare a similar drawing with a parts list for an instruction manual.
b. Prepare a specifications list.

Equipment (Group of 5)

5	12″ rules
1	stapler
1	triangle
1	protractor or irregular curve

Supplies

5 pcs.	8½″ x 11″ paper
5	drawing pencils
1	file folder from ACTIVITIES 13A-D
1 set	colored pencils

Preparing to Work

1. Get your equipment and supplies.

Preparing Illustration

2. Study Fig. 14-1. It is an *exploded* view of a LSRAV. You are to draw a view like this, *showing the LSRAV you designed.* Follow instructions in Steps 3 through 12.
3. First make a light sketch of the body.
4. Darken the straight lines, using a straightedge to guide your pencil. Working carefully, darken the curved lines freehand or with a curve.
5. Through each bearing hole draw a *center line,* as shown, using your straightedge. This is a series of long and short, alternating dashes. It extends beyond the vehicle body and marks the centers of bearings, axles, and wheels.
6. Sketch the bearings on the near side of the body.
7. Sketch the axles, washers, and wheels.
8. Darken the lines when the sketched parts are located properly.
9. Beside each part draw a circle about ⅜″ in diameter, as on Fig. 14-1. These circles are called *balloons.*
10. Extend a leader from each balloon to one part. Carefully draw arrowheads, as shown, on the leaders.
11. Add reference numbers in the balloons. A reference number is the part number you assigned to each component.
12. Prepare a parts list. Refer to work done in ACTIVITY 12C.
13. On another sheet of paper, list the LSRAV specifications. Refer to the data collected in previous activities, and to Fig. 14-2.
14. Sign and date the illustration and the specifications list.

84

60

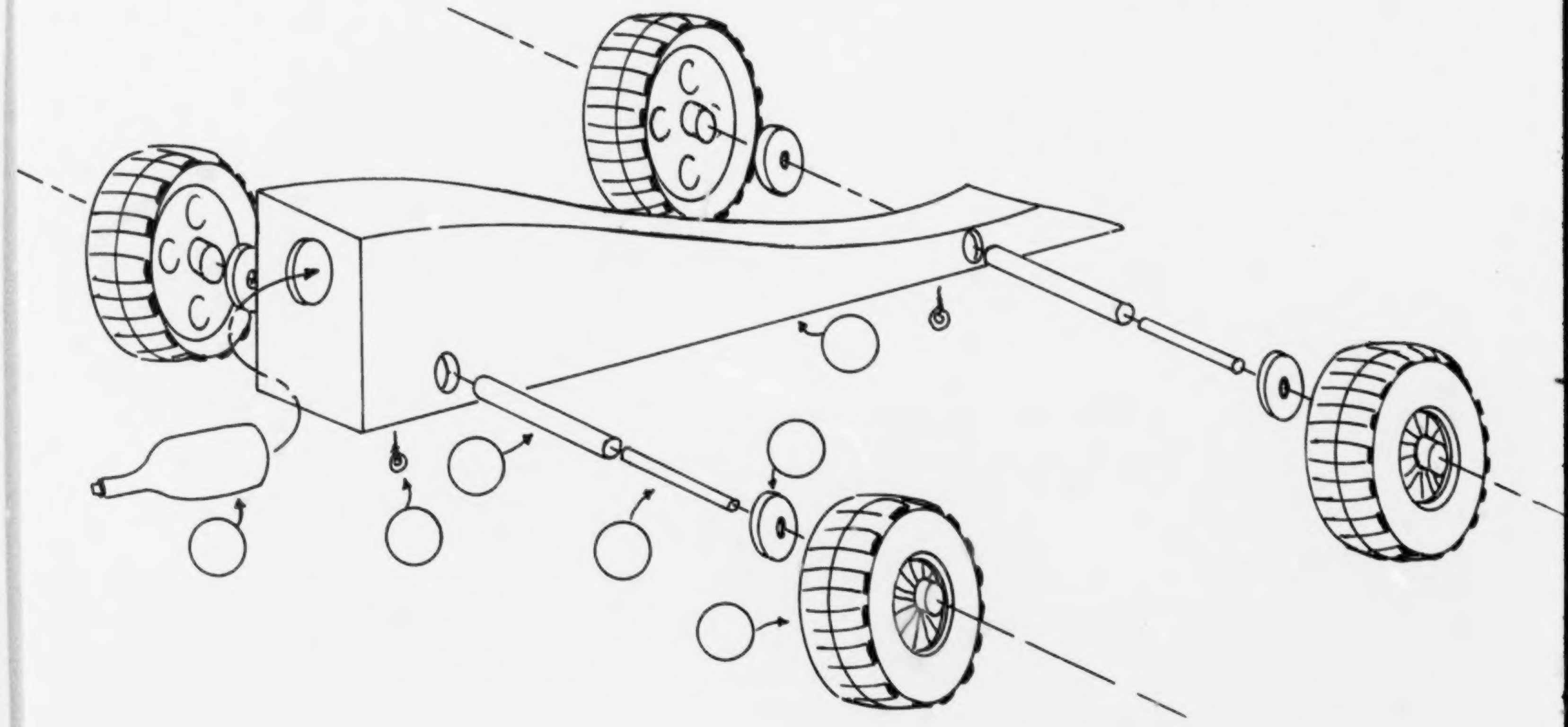


Fig. 14-1. Exploded View of Land Speed Record Assault Vehicle

Parts List		
Part No.	Name of part	No. of Parts
1	LSRAV Body	

Name Date

Fig. 14-2. Specifications of LSRAV

Weight (with engine)____________________

Length ____________________

Width (max.)____________________

Height (max.)____________________

Road clearance (road to bottom of car)____________________

Axle diameter ____________________

Bearing material____________________

Wheel size (outside dia.)____________________

Model speed (from Fig. 13E-1)____________________

Engine size (length and dia.)____________________

Track length (40′, 50′, or 60′)____________________

ASSEMBLY:

Assemble parts of LSRAV as shown in large drawing.

OPERATION:

1. Make certain wheels are securely fastened to axles and that axles turn freely.
2. Attach LSRAV to tether line.
3. Make sure tether line is secure at starting pit and finish pit.
4. Place sponges in location at finish pit.
5. Check timing lights.
6. Clear the track.
7. Insert cartridge.
8. Ready pit crews and timers with stopwatches.
9. Cock injector pin and fire.

SAFETY:

1. Pull back injector pin carefully.
2. Be sure track is clear.
3. Be sure CO_2 cartridge is inserted fully in the engine housing.

Fig. 14-3. Instructions for Assembling and Operating LSRAV

Problem 2

Objective

Using a model prototype of LSRAV and suggestions,

a. Prepare operation instructions for the LSRAV.
b. Assemble the instruction manual.

Supplies (Group of 5)
15 pcs. 8½″ x 11″ paper

1. Figure 14-3 is a suggested set of instructions for assembling and operating the LSRAV. Study them.
2. Make notes about other advice or instructions that you think should be added.
3. Discuss the operating instructions within the group.
4. On a clean sheet of paper prepare your own set of instructions. Write or letter clearly.
5. Sign and date this sheet.

Assembling the Instruction Manual

6. Assemble all the sheets you made today, as follows:
   Cover. Cover Sheet (blank)
   Page 1. Illustration and Parts List
   Page 2. Specifications
   Page 3. Operating Instructions
7. Staple the manual together with two staples along the left-hand edge, to form a book.

Cleaning Up

8. Return equipment and supplies, and clean up the work area.

Problem 3 (Optional)

Objective

Using original sketches or photographs, prepare a cover sheet for the LSRAV instruction manual.

Equipment (Class)
1 Polaroid camera, if available

Supplies (Class)
film for Polaroid camera *or* colored pencils
25 pcs. 8½″ x 11″ white or colored construction paper

Preparing Cover Sheet

1. If time permits and a camera is available, photographs may be taken of LSRAV's and the race track.
2. If no camera is available, you may develop original sketches of racing scenes.
3. Prepare a cover sheet for your manual, using either a photo or a colored sketch. Develop your own design ideas.

Questions

1. Instruction manuals are prepared by technical wr______________ and technical il__________________.
2. Maintenance manuals are written for ______________________________
3. Why are technical writers needed? ______________________________ ______________________________
4. Where in an instruction manual would you find the name and number of a part? ______________________________

ACTIVITY 15

Designing Manufactured Goods

Problem

Objective

Given the overall size for salt and pepper shakers,

a. Make thumbnail sketches of design ideas.
b. Develop three rough sketches.
c. Refine the best rough sketch.

Supplies (Group of 5)

5 shts. 8½″ x 11″ tracing paper
1 file folder
15 shts. 8½″ x 11″ white paper
5 colored pencils *or* felt markers, assorted colors

Preparing to Work

1. Meet with your group and get the needed equipment and supplies.
2. The recorder for your group will letter "Salt and Pepper Shaker" on the file folder tab, along with your group number. Each member of the group is to *letter his full name* on the front of the *file folder*.

Formulating the Problem

3. As a group of industrial designers, you are faced with the problem of designing salt and pepper shakers.

Using Data

4. It is your job to design salt and pepper shakers whose overall dimensions of *thickness, width, and height* will be within the limits 1¼″ x 1¼″ x 3″. See Fig. 15-1. You will also need to include in the design a means of telling the salt shaker from the pepper shaker.

Thumbnail Sketching

5. Based on the given size limits, make thumbnail sketches of your preliminary design ideas for salt and pepper shakers. See Fig. 15-2.
6. Record *all* your ideas as thumbnail sketches or notes.

Developing Ideas

7. Develop three rough sketches from alternate design ideas. See Fig. 15-2.

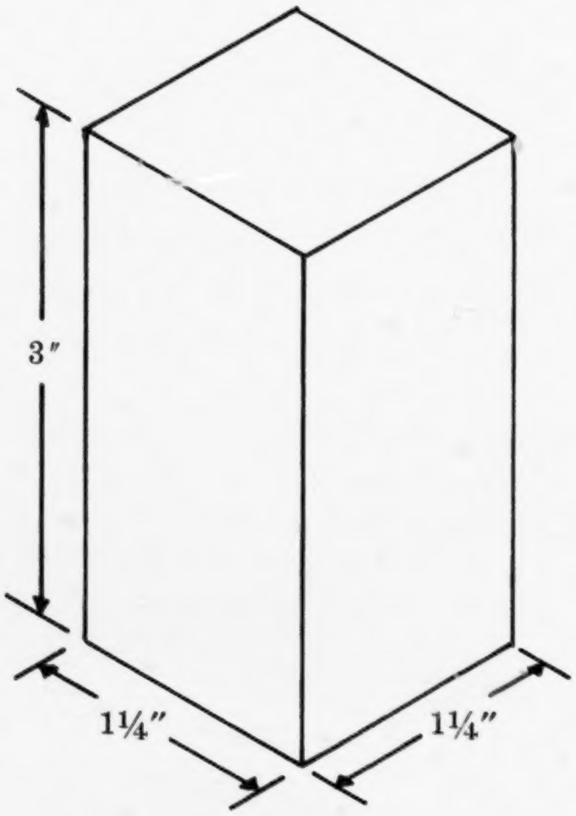


Fig. 15-1. Basic Dimensions of Salt and Pepper Shakers

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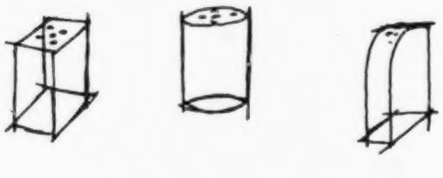
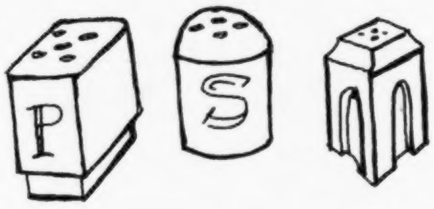
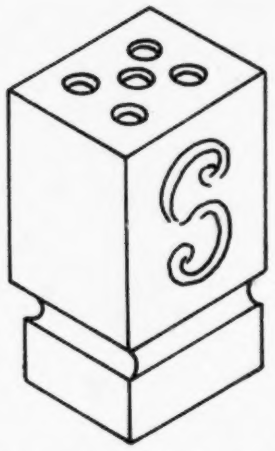


Thumbnail Sketches



Rough Sketches



Refined Sketch of the Selected Best Design

Fig. 15-2. Salt and Pepper Shaker Design Development from Thumbnail to Refined Sketch

Refining a Rough

8. Choose and refine the rough sketch of your best design idea. Use tracing paper. Pick up parts of the sketch that you like and add improvements.
9. Use color to show your ideas about decoration or trim details.

Certifying

10. Sign and date all your sketches in the *lower right corner.*

Voting

11. *As a class, select one best design by voting.*

Cleaning Up

12. Your recorder will collect and file the sketches, turn in the file folder, and give the best design from the class to the teacher.

Questions

1. What do designers call the first sketches they make?

   ____

2. A ro__________sketch is developed from a thumbnail sketch.
3. After refining the most promising design from several roughs or from several alternate design ideas, what step will the design department take next?

   ____

4. Why are alternate design solutions needed?

   ____

   ____

   ____

ACTIVITY 16

Obtaining Approval of Management

Problem

Objective

Using a product design created in ACTIVITY 15, represent management or stockholders in discussing whether to accept or reject a product design.

Supplies (Class)

1 mock-up, based on design chosen in ACTIVITY 15

Preparing to Meet

1. Your teacher will choose three students to represent management. One of these will be the *president*.
2. One of the students whose design was chosen in ACTIVITY 15 will play the role of product *designer*.
3. The *management team, production expert* (teacher), and *designer* will meet around a table in front of the class with the chosen mock-up displayed on the table.
4. The rest of the class will remain in their seats and act as *stockholders*.

Presenting the Design

5. The product *designer* will begin the meeting by *describing features* of the design. These features may include:
   a. Style
   b. Materials
   c. Colors available
   d. Age group for which the product was designed.
6. The *production expert* will then present his views. These might involve:
   a. Production
   b. Need to purchase new machinery
   c. Need to expand the plant
   d. Need to change plant layout.
7. Members of the *management group* will now question the design features:
   a. How can we tell the difference between the salt and pepper?
   b. How many of the product can we expect to make this year?
8. The *stockholders* (silent up to now) will be asked by the management team to *offer any comments* they might have about the proposed design.
9. Design and production experts working together will try to assure the management group of the success of the product.

Accepting or Rejecting the Design

10. The president will ask his two management assistants for their recommendations, but he will make the final decision.
11. If the president decides to accept the final design, the three managers will sign and date a copy of the *Design Release Form*. See Fig. 16-1. The form should be removed from *one copy* of the Laboratory Manual for this purpose. If the design is rejected, a designer from another group will present his design solution.
12. Mock-ups and the completed *Design Release Form* should be returned to the production expert (the teacher).

Fig. 16-1. Design Release Form

The salt and pepper shaker mock-up designed by ______________________,

and dated ______________, at a meeting with:

Production Expert ______________________________

President ______________________________

Designer ______________________________

is hereby released for production. Management team signs:

1. ______________________________
2. ______________________________
3. ______________________________

ACTIVITY 17

Making Working Drawings

Problem

Objective

Using a partially completed working drawing of salt and pepper shakers and the accepted design solution:

- a. Complete the view of the working drawing.
- b. Dimension, add notes, and complete the title block.

Equipment (Group of 5)

5	12″ rules

Supplies (Group of 5)

5 pcs.	8½″ x 11″ tracing paper
1	file folder from ACTIVITY 15
20	paper clips

Preparing to Work

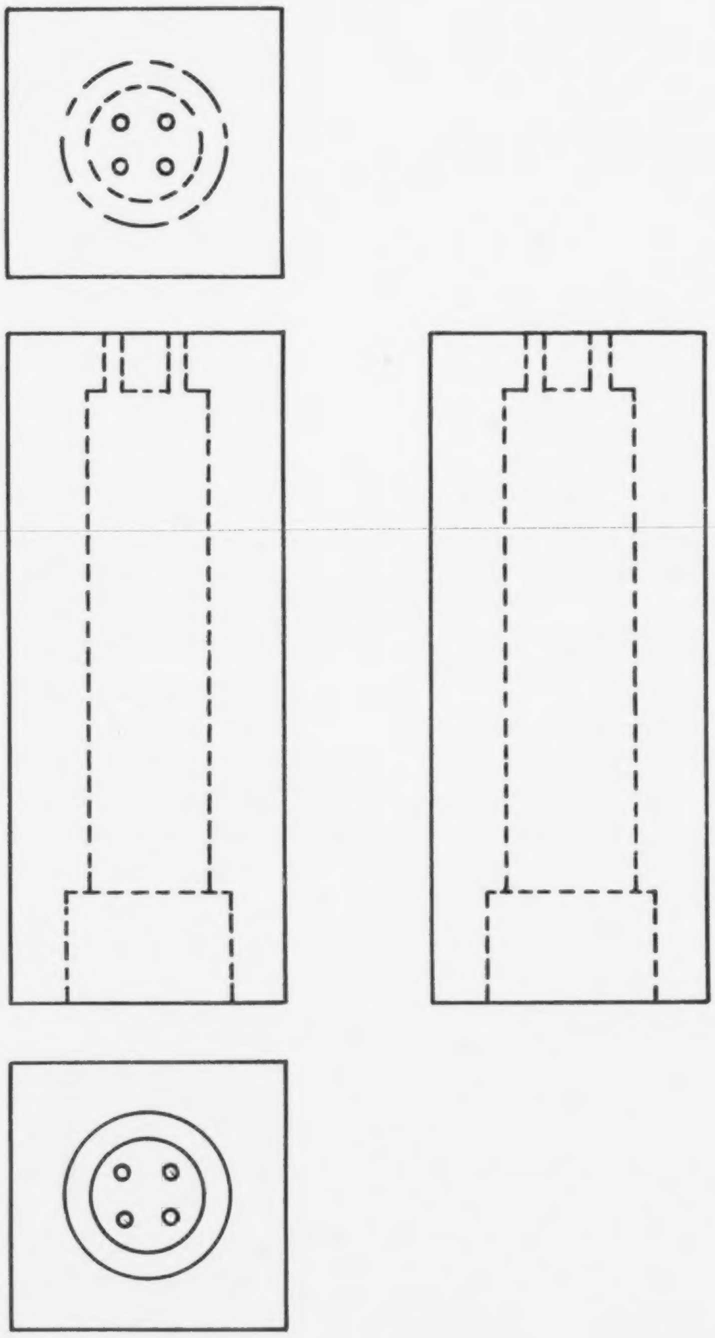
1. Get the needed equipment, supplies, and file folder.

Completing the Drawing

2. Figure 17-1 is an incomplete working drawing of a salt shaker. On this drawing lightly sketch the special design features chosen for your class. A complete drawing will be shown on the projection screen to guide you.
3. Check the locations and sizes of the added features with the other members of your group. Make any needed corrections.
4. Darken the lines after you are sure that your drawing is correct.
5. Fasten a piece of tracing paper over the drawing, using paper clips. Carefully trace the drawing, using a straightedge to guide your pencil.

Dimensioning

6. On your tracing enter *extension lines and dimensions* which give the locations and sizes of the special design features. They are shown on the projection screen. *Draw arrowheads and extension lines neatly.*
7. Add all notes to your drawing, as shown on the projected transparency.
8. The recorder will collect drawings, and return them to the group's folder. The equipment supervisor will return the equipment.



BILL OF MATERIALS	SCALE	IACP MANUFACTURING CO.
1 Pc. No. 4 Cork ½" Dia. 2 Pcs. Pine 1¼" × 1¼" × 3"	Drawn by Traced by Checked by Approved by	SALT AND PEPPER SHAKERS

Fig. 17-1. Working Drawing of Salt and Pepper Shakers

ACTIVITY 18A, B

Planning Production

Today you will manufacture a salt shaker by hand processes. By so doing, you will begin building the production prototype.

Problem 1

Objective

Using the supplies and equipment and a demonstration on processes, cut a piece of stock to length.

Equipment (Class)

4	12″ rules
4	crosscut saws

Supplies (Class)

2	1¼″ x 1¼″ x 48″ wood stock

Hand Sawing

1. Using a pencil and rule, measure and draw a line 3″ from the end of a piece of stock.

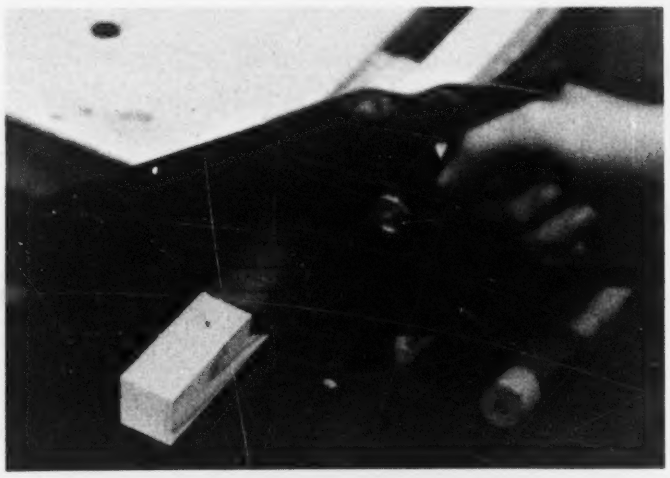


Fig. 18A-1. Secure Wood in a Bench Vise and Cut with a Crosscut Saw

2. Place the wood in a bench vise. See Fig. 18A-1.
3. Using the crosscut saw, cut off the 3″ piece of wood.
4. Remove the remaining stock from the vise and place it on the bench.
5. How could this operation have been done more efficiently?

____

____

6. Take your *salt shaker block* to Bench #2.

Problem 2

Objective

Using the supplies and equipment, counterbore the salt shaker block.

Equipment (Class)

1	brace
1	¾″ auger bit
1	12″ rule

Supplies (Each student)

1	salt shaker block from Problem 1

Hand Counterboring

1. Place the salt shaker block in a bench vise.
2. Using the brace and auger bit, counterbore a hole ½″ deep in one end. See Figs. 18A-2A and 18A-2B. Select the most comfortable position (vertical or horizontal) for boring the hole.
3. How could this operation have been done more efficiently?

____

____

4. Remove the salt shaker block from the vise and take it to Bench #3.

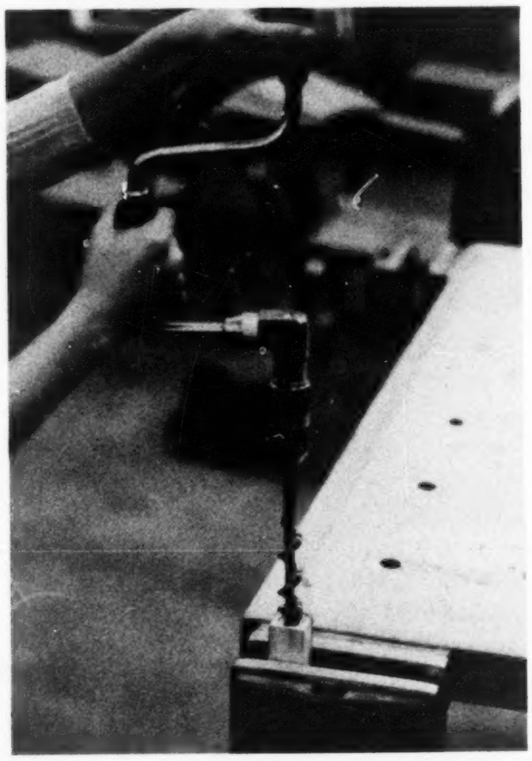


Fig. 18A-2A. Holding the Brace and Bit Vertically

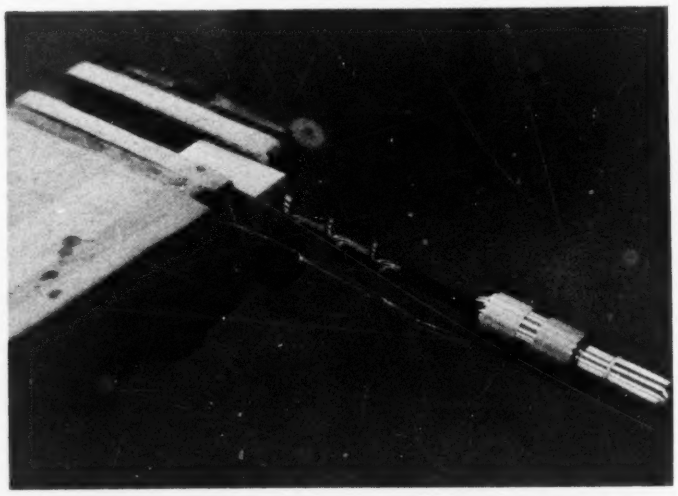


Fig. 18A-2B. Holding the Brace and Bit Horizontally

Problem 3

Objective

Using the supplies and equipment, bore the salt shaker block.

Equipment (Class)

1	brace
1	½″ auger bit
1	12″ rule

Supplies (Each student)

1	salt shaker block from Problem 2

Hand Boring

1. Place the salt shaker block in a bench vise.
2. Using the brace and auger bit, bore a hole 2¾″ deep in the end that you counterbored.
3. How could this operation have been done more efficiently?

   ____

   ____

4. Remove the salt shaker block from the vise and take it to Bench #4.

Problem 4

Objective

Using the supplies and equipment, drill outlet holes in the salt shaker block.

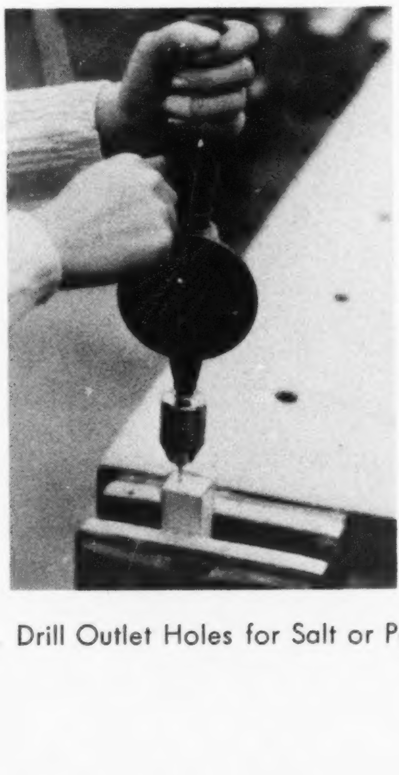


Fig. 18A-3. Drill Outlet Holes for Salt or Pepper

Equipment (Class)
1 hand drill
1 salt drilling jig No. 41-1; $\frac{3}{32}''$ holes
1 $\frac{3}{32}''$ twist drill

Supplies (Each student)
1 salt shaker block from Problem 3

Hand Drilling

1. Place the salt shaker block in a bench vise.
2. Using the hand drill and twist bit, drill 4 outlet holes in the end that was not bored and counterbored. See Fig. 18A-3.
3. How could this job have been done more efficiently?

   ____

   ____

4. Remove the salt shaker block from the vise and take it to Bench #5.

Problem 5

Objective

Using the supplies and equipment, sand the sides and ends of the salt shaker block.

Equipment (Class)
4 $\frac{3}{4}'' \times 2'' \times 4''$ sanding blocks

Supplies (Class)
1 sht. fine sandpaper (cut into 4 pieces)

Supplies (Each student)
1 salt shaker block from Problem 4

Hand Sanding

1. Place the salt shaker block in a bench vise.
2. Using the sandpaper and sanding block, smooth the sides and ends of the salt shaker block.
3. What equipment could have been used to give you a better job?

   ____

   ____

4. Remove the salt shaker block from the vise and take it to Bench #6.

Problem 6

Objective

Using the supplies and equipment, finish the salt shaker block.

Equipment (Class)
1 $\frac{1}{2}''$ finishing brush
1 soup can to hold brush

Supplies (Class)
1 pt. clear lacquer
1 pt. lacquer thinner
newspaper

Supplies (Each student)
1 salt shaker block from Problem 5

Hand Finishing

1. Put your initials on the bottom (bored and counterbored end) of the salt shaker block.
2. Using the paint brush, apply a coat of clear lacquer to the top and sides.
3. How could this operation have been done more efficiently?

   ____

   ____

4. Rate your finished product. Be honest.

   Excellent ________ Good ________

   Fair ________ Poor ________
5. Are all of the salt shaker blocks in the class exactly alike?

   Yes ________ No ________
6. Put your salt shaker block in the place directed by your teacher.
7. Give your Laboratory Manual to your equipment supervisor, wash your hands and return to your seat.

ACTIVITY 18C

Planning Production

Today you will manufacture a pepper shaker, using machines, jigs, and fixtures. By so doing, you will complete work on the production prototype. You will compare today's results with yesterday's results to determine the most efficient process.

Problem 1

Objective

Using the supplies and equipment, cut a piece of stock to length.

Equipment (Class)

5	miter boxes with stop-blocks
5	back saws

Supplies (Class)

2	$1\frac{1}{4}'' \times 1\frac{1}{4}'' \times 48''$ wood stock

Miter Sawing

1. Place the stock in the miter box.
2. Be sure the stock is tight against the stop block.
3. Hold the stock firmly in place.
4. Cut off a piece of wood. See Fig. 18C-1.
5. Place the remaining stock on the bench.
6. Take your pepper shaker block to Drilling Station #1.

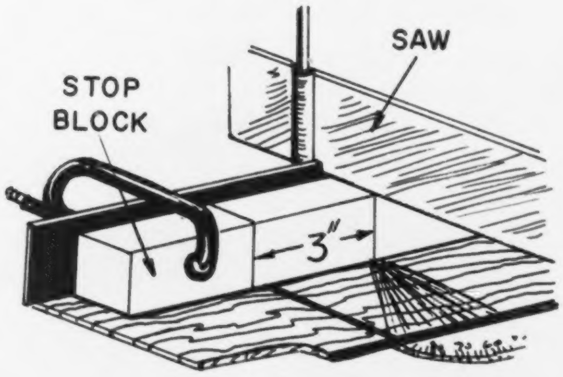


Fig. 18C-1. Cutting Accurately with a Miter Box Saw

Problem 2

Objective

Using the supplies and equipment, counterbore the pepper shaker block.

Equipment (Class)

1	drill press with fixture in place and stop preset
1	counterboring fixture
1	"C" clamp
1	$\frac{3}{4}''$ forstner bit or spade bit

Supplies (Each student)

1	pepper shaker block from Problem 1

Safety

1. DO *NOT* turn the drill press on or off for another student.
2. Wear safety goggles when operating this machine.

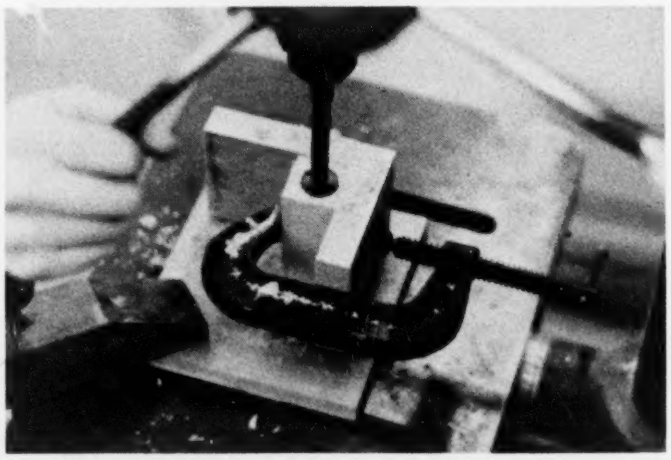


Fig. 18C-2. C-Clamp the Block in the Holding Fixture

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Counterboring

1. Place the pepper shaker block in the fixture on the drill press table.
2. Using the "C" clamp, clamp the pepper shaker block in place. See Fig. 18C-2.
3. Counterbore the pepper shaker block until the drill press reaches the stop.
4. Remove the pepper shaker block from the fixture and take it to Drilling Station #2.

Problem 3

Objective

Using the supplies and equipment, bore the pepper shaker block.

Equipment (Class)

1	drill press with fixture in place and stop preset
1	boring fixture
1	"C" clamp
1	½″ forstner bit *or* spade bit

Supplies (Each student)

1	pepper shaker block from Problem 2

Safety

1. DO *NOT* turn the drill press on or off for another student.
2. Wear safety goggles when operating this machine.

Boring

1. Place the pepper shaker block in the fixture on the drill press table.
2. Using the "C" clamp, clamp the pepper shaker block in place.
3. Bore the pepper shaker block until the drill press reaches the stop.
4. Remove the pepper shaker block from the fixture and take it to Bench #2.

Problem 4

Objective

Using the supplies and equipment, drill the outlet holes in the pepper shaker block.

Equipment (Class)

1	pepper Drilling Jig No. 41-2; 1/16″ holes
1	spring clamp
1	electric hand drill
1	1/16″ twist drill

Supplies (Each student)

1	pepper shaker block from Problem 3

Safety

Wear safety goggles when operating the electric hand drill.

Drilling

1. Place the pepper shaker block in the drilling fixture with the counterbored and bored holes down.
2. Using the spring clamp, clamp the pepper shaker block in place.
3. Using the electric hand drill, drill the four outlet holes. Be sure to drill the holes *straight.* See Fig. 18C-3.
4. Remove the pepper shaker block from the fixture and take it to the sander.

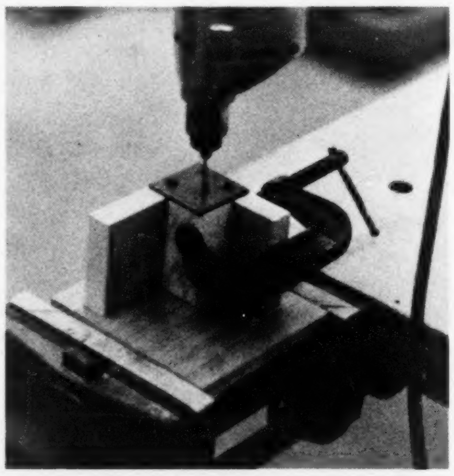


Fig. 18C-3. Using a Drilling Fixture to Accurately Locate Outlet Holes in the Salt and Pepper Shakers

Problem 5

Objective

Using the supplies and equipment, sand the sides and ends of the pepper shaker block.

Equipment (Class)
1 belt or disc sander with fine sandpaper

Supplies (Each student)
1 pepper shaker block from Problem 4

Safety

1. Wear safety goggles.
2. Be careful to keep your fingers clear of the sanding machine.

Sanding

1. Using the belt or disc sander, smooth the sides and ends of the pepper shaker block.
2. Take the pepper shaker block to Bench #3.

Problem 6

Objective

Using the supplies and equipment, finish the pepper shaker block.

Equipment (Class)
1 cardboard box

Supplies (Class)
1 spray can clear acrylic lacquer

Supplies (Each student)
1 pepper shaker block from Problem 5

Finishing

1. Put your initials on the bottom of the pepper shaker block.
2. Place the pepper shaker block in the cardboard box.
3. Spray the top and sides of the pepper shaker block with clear acrylic lacquer.
4. Put the completed pepper shaker block in the place directed by your teacher.
5. You have now completed building the salt and pepper shaker *production* prototype. Go on to Problem 7.

Problem 7

Objective

Using the completed salt and pepper shaker blocks, compare the two and determine which processes were more efficient.

1. Look at your completed salt shaker block. How was it made?

   ____

   ____

2. Look at your completed pepper shaker block. How was it made?

   ____

   ____

3. Rate your finished pepper shaker block.

   Excellent ________ Good ________

   Fair ________ Poor ________

4. Are all of the pepper shaker blocks in the class alike?

   Yes ________ No ________

5. Using the completed shaker blocks, fill out the Process Comparison Chart. See Fig. 18C-4.
6. Give your Laboratory Manual and shaker blocks to your equipment supervisor, wash your hands and return to your seat.

Fig. 18C-4. Process Comparison Chart

	Salt Shaker	Pepper Shaker
1. Was the shaker cut to the proper length?	no	yes
2. Was the shaker cut perfectly straight?		
3. Was the counterbore hole exactly in the center?		
4. Was the counterbore hole the correct depth?		
5. Was the bored hole centered in the counterbore hole?		
6. Was the bored hole perfectly straight?		
7. Was the bored hole the correct depth?		
8. Were the 4 pour holes drilled into the filler hole?		
9. Was the shaker smooth?		
10. Was the sanding operation fast?		
11. Was the coat of lacquer even?		
12. Based on the results of the chart, was this shaker produced by the most efficient method?		

ACTIVITY 18D

Planning Production

Today you will work in one of six groups, each assigned a different process planning task.

Problem

Objective

Given one of six processes to be used in manufacturing salt and pepper shakers, prepare an operation sheet for that process.

Planning Processes

1. Each group will develop an operating sheet for one of these processes:
   Group 1 — Cutting stock to length
   Group 2 — Counterboring filler holes
   Group 3 — Boring filler holes
   Group 4 — Drilling pour holes
   Group 5 — Sanding
   Group 6 — Finishing
2. Discuss how each operation was performed with the other members of your group.
3. Fill out the operation sheet: list the operations in the order in which they are to be performed. See Fig. 18D-1.
4. At the bottom of the operation sheet list the equipment and supplies needed for the process. See Fig. 18D-1.
5. Give your Laboratory Manual to your regular equipment supervisor and return to your seat.

Fig. 18D-1. Operation Sheet

Product to Be Manufactured:____________________

Process to Be Analyzed:____________________

Step	Description of Operation	Hand Tool	Machine Tool
0	Example: Saw 3″ block to length	miter saw	
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Equipment and Supplies Needed for This Set of Operations

ACTIVITY 19

Planning Processes

Today you will (1) *develop a plan* for producing salt and pepper shaker sets, and (2) *make a production flowchart.*

Problem

Objective

Using the operation sheets required to manufacture salt and pepper shakers, *develop a production plan and a flowchart.*

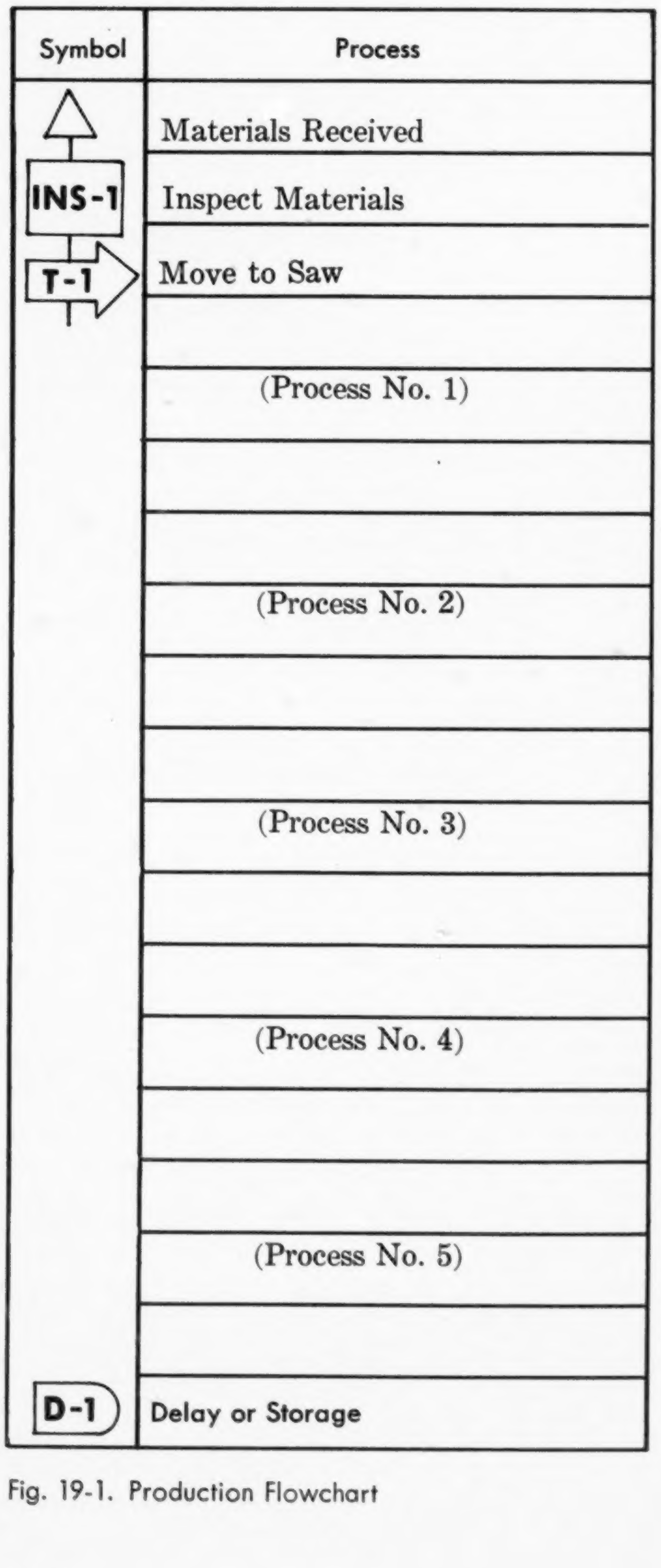
Supplies (Each student)
2 shts. 8½″ x 11″ paper
5 operation sheets from ACTIVITY 18D (to be shared)

Preparing to Work

1. Meet with your usual group of 5.
2. The group foreman will get from the teacher one set of the operation sheets that was completed in the last activity. The teacher will provide an operation sheet for the process he demonstrated.

Making Flowchart

3. First, as a group, arrange the six operation sheets in the order that is necessary to change the raw material into salt and pepper shakers.
4. Fig. 19-1 is a Production Flowchart. Assume that the wood has been inspected and delivered to the saw. It is ready for processing. Enter the names of the processes on the proper lines, as shown.
5. To the left of each of the six processes draw the *operation* symbol. See Fig. 19-2. Number each operation symbol, starting with O-1, O-2, O-3, etc. See Fig. 19-2.
6. Draw an inspection symbol below each process symbol. Number these INS-1, INS-2, etc. See Fig. 19-2.
7. Record what is being inspected on the second line of each block in Fig. 19-1;



Symbol	Process
△	Materials Received
INS-1	Inspect Materials
T-1	Move to Saw
	(Process No. 1)
	(Process No. 2)
	(Process No. 3)
	(Process No. 4)
	(Process No. 5)
D-1	Delay or Storage

Fig. 19-1. Production Flowchart

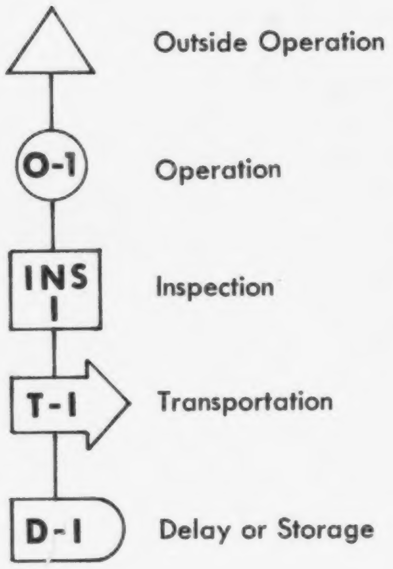

Outside Operation
O-1
Operation
INS
I
Inspection
T-I
Transportation
D-I
Delay or Storage

Fig. 19-2. Flowchart Symbols

for example, "Inspect pour hole," or "Inspect filler hole."

8. Draw a *transportation* symbol below each inspection symbol and number these T-1, T-2, T-3, etc.
9. Record where the material is to be transported on the third line in each block.
10. Connect each symbol to the one below it with a line. See Fig. 19-2. This shows the flow or movement of a workpiece through production.
11. Give your Laboratory Manual to your equipment supervisor for storage.

ACTIVITY 20

Designing and Engineering the Plant

Problem

Objective

Using templates, a list of restrictions, and a routing schedule, design a floor plan for a manufacturing plant.

Equipment (Group of 5)
1 pr. scissors

Supplies (Group of 5)
1 roll transparent tape

Preparing to Work

1. Figure 20-1 is a list of design restrictions that you will need to know before you begin the floor plan. Study it carefully.
2. Study the Routing Schedule in Fig. 20-2.

Cutting Out Templates

3. Use scissors to cut out the templates in Fig. 20-3. Cut on the *dashed lines* so that the needed work area will be allowed for each area.

Designing the Plant

4. After the templates have been cut out, they should be arranged on the floor plan scale drawing, Fig. 20-4. Keep rearranging the templates until you have what appears to be the best possible design. Make sure that your design will permit efficient routing. Check your plan with the routing schedule.
5. When you are satisfied with your design, tape the templates to the floor plan.

Questions

1. Was your first design the one you decided to record?

   ____ Yes ____ No

2. A new plant may be designed either by company engineers or by an outside engineering firm.

   ____ Yes ____ No

3. One of the first things the plant designer must do is to analyze the products to be manufactured.

   ____ Yes ____ No

4. Most production plants are laid out into various areas or departments.

   ____ Yes ____ No

5. In your own words, tell why templates are helpful in designing a manufacturing plant.

   ____

   ____

   ____

   ____

   ____

1. The plant will produce salt and pepper shakers just like the ones that you have manufactured.
2. There is a scale drawing of the plant floor, laid off in 1′ squares.
3. The floor plan of the manufacturing plant is to be arranged on this drawing, using the templates in the Laboratory Manual.
4. The major traffic lanes should be 8′ wide and the minor traffic lanes 4′ wide. Keep in mind that on the drawing each edge of a square represents 1′ to scale.
5. On the scale drawing notice the area labeled "unloading dock". Materials delivered to the manufacturing plant will be received at this dock.

Fig. 20-1. Design Restrictions

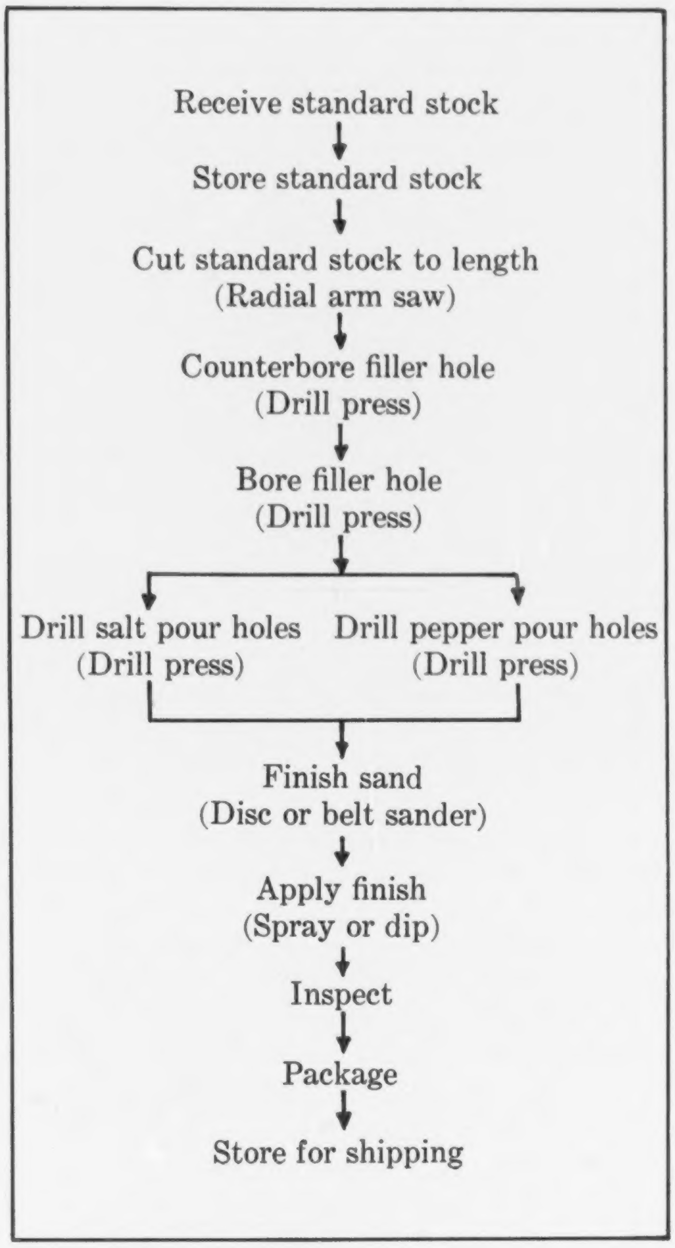

Receive standard stock
Store standard stock
Cut standard stock to length
(Radial arm saw)
Counterbore filler hole
(Drill press)
Bore filler hole
(Drill press)
Drill salt pour holes
(Drill press)
Drill pepper pour holes
(Drill press)
Finish sand
(Disc or belt sander)
Apply finish
(Spray or dip)
Inspect
Package
Store for shipping

Fig. 20-2. Suggested Routing Schedule

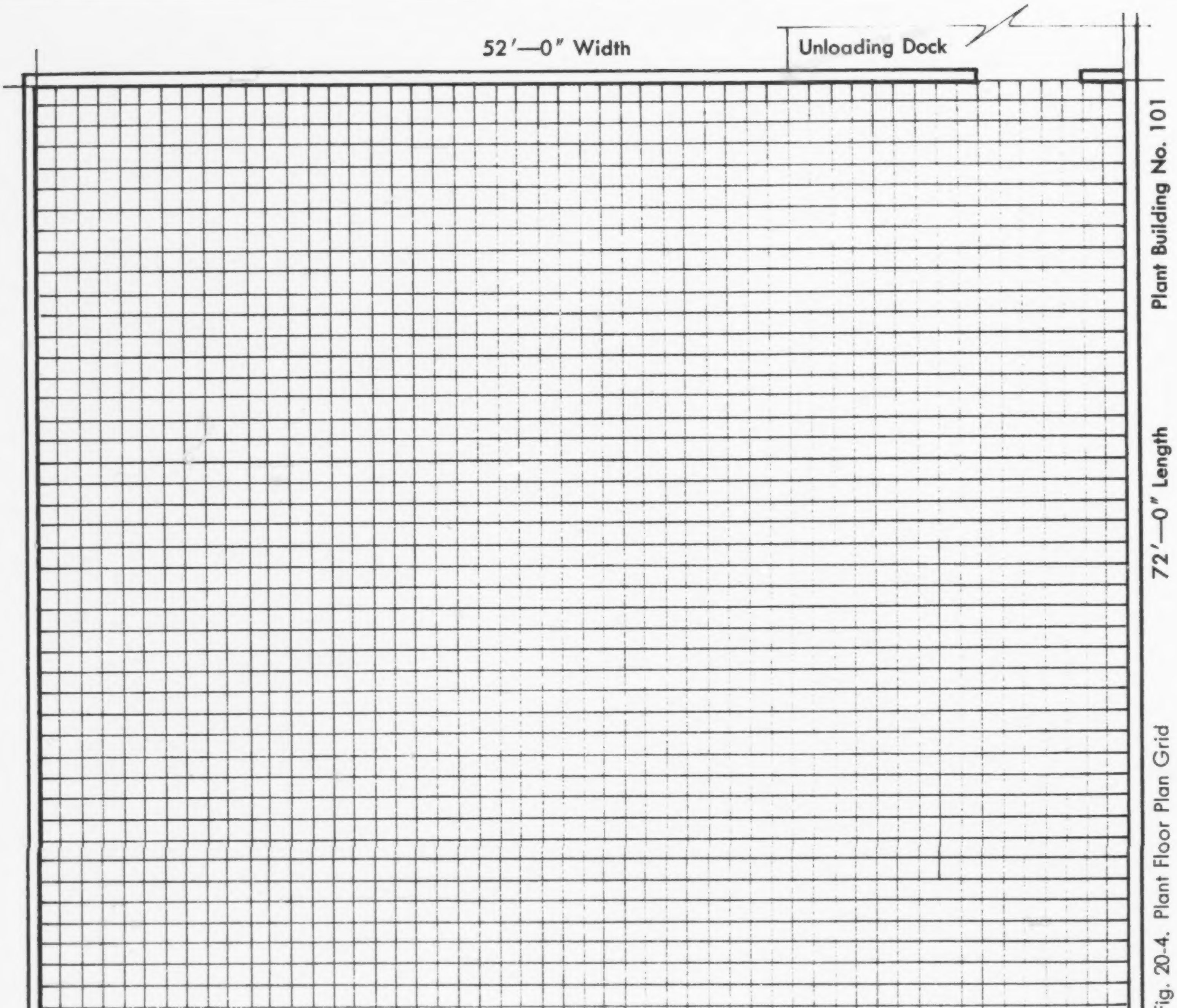

52'—0" Width
Unloading Dock
Plant Building No. 101
72'—0" Length
Scale: 1/8" — 1'—0"
Men's Washroom
Women's Washroom
To Parking Lot

Fig. 20-4. Plant Floor Plan Grid

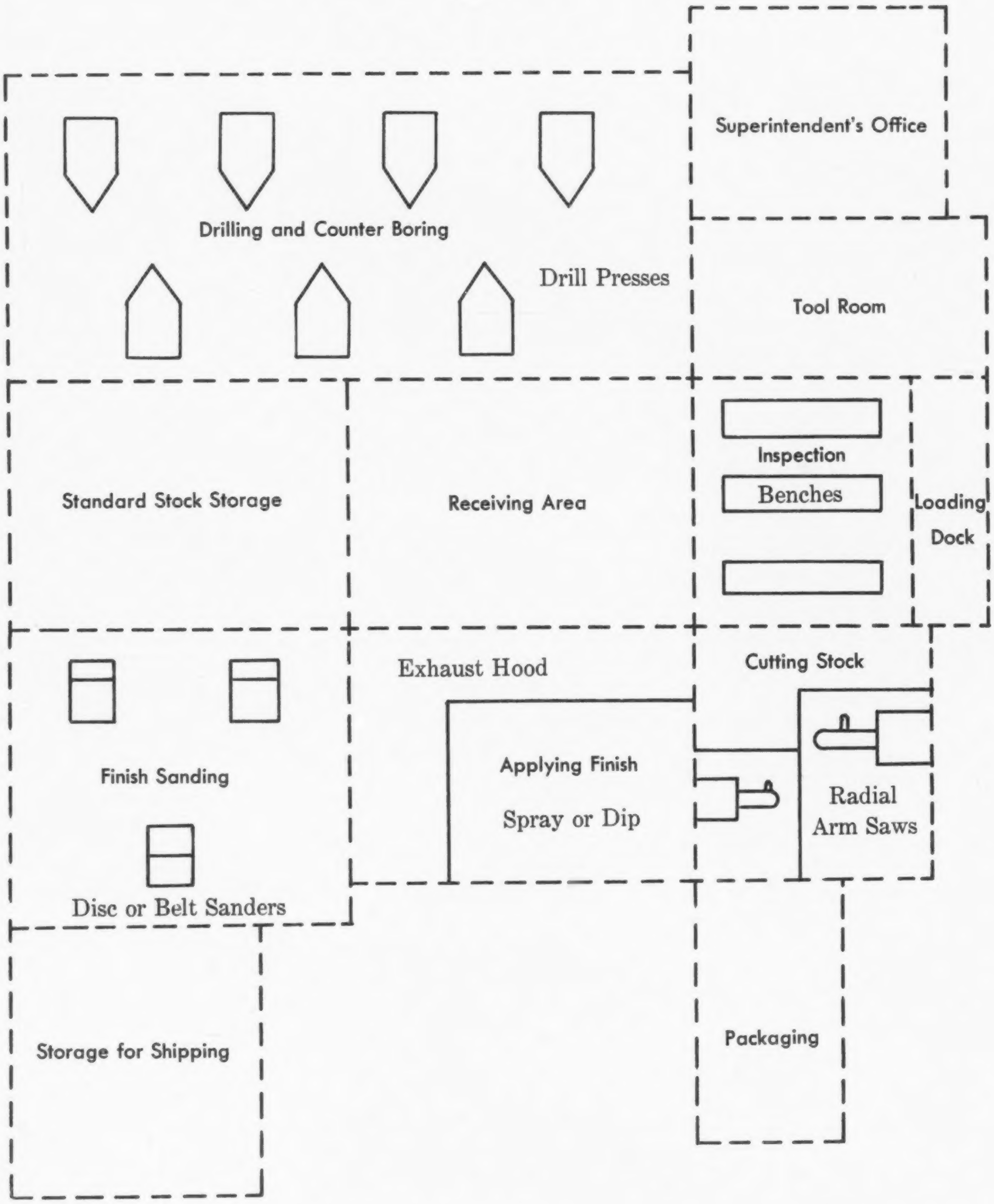

Superintendent's Office
Drilling and Counter Boring
Drill Presses
Tool Room
Standard Stock Storage
Receiving Area
Inspection
Benches
Loading Dock
Exhaust Hood
Cutting Stock
Finish Sanding
Applying Finish
Spray or Dip
Radial Arm Saws
Disc or Belt Sanders
Storage for Shipping
Packaging

Fig. 20-3. Template Sheet
Note: Cut only on dotted lines.

ACTIVITY 21

Supplying Equipment and Materials

Problem

Objective

Using a list of items that management has approved for purchasing, take part in *bidding and purchasing activities* between a purchasing department and several vendors.

Equipment (Class)

5	different equipment supply catalogs, Brodhead-Garrett, Sears, Paxton, Midwest, etc.
1	yardstick

Preparing to Work

1. Meet with your group.
2. Your teacher will assign group titles as follows:
   Group 1 — Purchasing Department for a manufacturer
   Group 2 — Vendor A
   Group 3 — Vendor B
   Group 4 — Vendor C
   Group 5 — Vendor D
   Group 6 — Vendor E
3. Each vendor group is to get an equipment catalog.

Vendors

4. Management has decided that the items listed on the Bid Form, Fig. 21-1, are to be purchased by its Purchasing Department. *Read this Bid Form list carefully.*
5. Each vendor group will *quote* the prices that are listed in their *catalog* as a basis for their *bid price.*

Quantity	Item Description	Unit Cost	Quantity Discount 10%	Shipping Fee	Total Cost
7	DRILL PRESS, 15″ floor model (utility, no accessories)		▨	$20.00	
2	RADIAL ARM SAW, (no accessories) 16″ w/table (arm for 16″ cut)		▨	$20.00	
3 doz.	HIGH SPEED STEEL DRILL 3/32″ diameter			$1.00	
2	COMBINATION BELT AND DISC SANDER, 6″ belt & 10″ disc		▨	$10.00	
3 doz.	GARNET SANDING BELT, 6″—fine grit			$1.00	
3 doz.	GARNET SANDING DISC, 10″—fine grit			$1.00	
2	SPRAY PAINTING OUTFIT without air compressor (all purpose gun and hose)		▨	$2.00	
5 gal.	SPRAY LACQUER, clear finish for wood		▨	$2.00	

Example

5 gal.	SPRAY LACQUER, clear finish for wood	$6.25		$2.00	$33.25

Fig. 21-1. Bid Form

6. Vendors are to include a small *fee* to cover *shipping costs* on the drill press, radial arm saws, and combination belt and disc sanders.
7. Vendors are to include a *quantity discount* of *10%* on any item if more than two dozen of the items are wanted.

Purchasing Department

8. While the vendors are determining the prices for the Bid Form, members of the Purchasing Department can copy the *Bid Analysis Form* (Fig. 21-2) on the chalkboard. Abbreviate whenever possible. Use a yardstick to draw straight lines.

Submitting Bids

9. After each vendor group has completed the *Bid Form,* it should be *returned* to the *Purchasing Department.* The foremen of the groups are to *see* that the bids are *submitted* in accord with the *general rules* given in Steps 5 through 7.
10. Members of the Purchasing Department should *collect* the completed *Bid Forms* and *record* the *results* on the chalkboard. *Students* in Groups 2-6 should *copy* these *figures* onto Fig. 21-2 in the Laboratory Manual.

Awarding Purchase Order

11. After all prices have been recorded on the chalkboard, the Purchasing Department can circle the best (lowest) price for each item.
12. The price circled will determine *which vendor is awarded the purchase order for each item.*

Fig. 21-2. Bid Analysis Form

Quantity	Item	Price Quoted by Bidder				
		Vendor A	Vendor B	Vendor C	Vendor D	Vendor E
7	DRILL PRESS, 15", floor model					
2	RADIAL ARM SAW, 16" w/table					
3 doz.	HIGH SPEED STEEL DRILL, drills $\frac{3}{32}$" diameter					
2	COMBINATION BELT AND DISC SANDER, 6" belt & 10" disc					
3 doz.	GARNET SANDING BELT, 6"—fine grit					
3 doz.	GARNET SANDING DISCS, 10"—fine grit					
2	SPRAY PAINTING OUTFIT, less Air Compressor					
5 gal.	SPRAY LACQUER clear finish for wood					

Example

5 gal.	SPRAY LACQUER clear finish for wood	$33.25	$36.00	$49.50	$28.75	$30.50

13. Members of the Purchasing Department can now determine:
    a. Which vendor has been awarded *the most purchase orders* and,
    b. The vendor group that will receive *the largest amount of money* from the purchase orders awarded to them.

Questions

1. The decision to make, buy, or lease equipment is made by m__________________.
2. Management authorizes its purchasing department to issue purchase orders.

   _____ Yes _____ No
3. What equipment to use and where to purchase it both are decided by analyzing the technical factors and the economic factors involved.

   _____ Yes _____ No
4. Purchasing Department personnel are concerned with the purchase of the right kind of equipment and materials from the most economical source, and with their delivery in the right quality and quantity to the right place at the right time.

   _____ Yes _____ No
5. The purchasing department is in charge of which of these? (*Circle one.*)
   a. Selecting potential suppliers.
   b. Issuing bid sheets (requests for quotations).
   c. Analysis of bid sheets returned.
   d. All of the above.

ACTIVITY 22

Employment and Occupations in Manufacturing

Problem

Objective

Given several occupations, decide how important *data, people,* and *things* are in doing each job.

Learning the Code

1. Figure 22-1 explains the code you will use today.
   a. Learn the meanings of the digits 0 to 8.
   b. Learn the meaning of each place in a three-digit set.

Digit	Meaning
0	Highest possible importance
1	(In rank order: less than
2	"Highest" but more than
3	"Average")
4	Average importance
5	(In rank order: less than
6	"Average" but more than
7	"Least")
8	Least possible importance

For example, the meaning of Place or Position for a job:

Data	8	(not important to the job)
People	0	(very important to the job)
Things	4	(important to the job)

Fig. 22-1. Occupational Code

Classifying Occupations

2. When an occupation is shown on the screen, think first about *data.* If you were performing this job, how much would you *work with information,* keeping records, writing data, ideas, and symbols? Choose a digit from Fig. 22-1 that shows the importance of *data* in this occupation.
3. Enter the digit in Fig. 22-2, under "Data".
4. Think next about *people.* In this occupation how much would you need to *deal with other people* by exchanging ideas, teaching subject matter, persuading, or attending to people's needs? Choose a digit to show the importance of people, and enter it in Fig. 22-2 under "People".
5. Next, evaluate the importance of *things.* In this occupation how much would you need to know about *using and handling equipment, tools, materials, or parts?* Choose a digit to show the importance of things, and enter it in Fig. 22-2, under "Things".
6. When your teacher tells you the correct code, enter it in the table also. Place a check (√) behind any wrong numbers.
7. Follow Steps 2 through 6 each time an occupation is shown.
8. You are to check your answers after completion of the activity. If each of the three digits is within ±1 of the correct one, consider your answer correct.

Fig. 22-2. Job Classifications

Job Title Start Here	Data	People	Things	Correct Code
1. Sewing Machine Operator	7	8	3✓	782 *
2. Industrial-Truck Operator				
3. Automobile Painter, sprayer				
4. Aircraft Assembler, structure and surfaces				
5. Engineering Designer, aircraft structure				
6. Leather Cutter				
7. Box Maker				
8. Engineering Assistant, mechanical equipment				
9. Fur Cutter				
10. Metallurgist				
11. Welder, arc				
12. Proof Pressman				
13. Production Foreman				
14. Shaper Machine Operator				
15. Plant Superintendent				
16. Automobile Assembler				
17. Electrical Wire Group Assembler				
18. Engine Assembly Foreman				
19. Mechanical Draftsman				
20. Metal Fabricating Foreman				
21. Proof Technician, small arms				
22. Wood Technologist				
23. Glass Inspector				
24. Furniture Assembler				
25. Cigar Packer				
26. Cloth Designer				
27. Men's & Boys' Clothing Salesman, wholesale				
28. Tire Inspector				

*** Example**

ACTIVITY 23

Automating Processes

Today you will help assemble and place a conveyor-belt system *to study some of the techniques and problems of mechanization.* If components have already been produced, you will only need to assemble and place the conveyor belt.

Problem 1
Groups 1, 2, 3 and 4

Objective

Using materials and specifications, *make a conveyor belt* appropriate for transporting salt and pepper shakers in production.

Equipment (To be shared)

2	drill presses
2	5/16″ drill bits
1	1″ Forstner bit
1	stapler
2	claw hammers
3 pr.	slip joint pliers
3	adjustable wrenches

Supplies (To be shared)

1 pc.	140′ plastic webbing, cut to fit conveyors (Teacher will cut to needed lengths.)
1 btl.	rubber cement

Equipment (Each group)

2	6″ C-clamps
1	spring clamp
1	pencil compass

Supplies (Each conveyor)

4 pcs.	¼″ x 6″ dia. plywood
2	4″ dia. qt. oil cans
2 pcs.	2″ x 4″ x 10½″ pine
4 pcs.	1″ dia. x 6″ dowel sticks
1 pc.	friction tape, 20′ long
2 pcs.	¼″-20 x 12″ threaded steel rod
6	¼″ - 20 hex nuts
10	lock washers, ¼″ I.D.
1 pc.	¾″ x 7½″ x 8′ to 12′ boards (conveyor bases)

Making a Conveyor Belt System

1. Your class will be divided into five groups. Groups 1, 2, 3, and 4 will each make a conveyor-belt system for transporting the salt and pepper shaker in production. Group 5 will do Problem 2.
2. Follow the instructions on the drawings for making and setting up the belt assembly. See Fig. 23-1 and 2. Share equipment.
3. Your *teacher will cut the webbing to length* when you are ready to set up your conveyor-belt assembly.
4. Set the conveyor system according to the teacher's directions. See Figs. 23-3, 23-4, and 23-5.

Objective

Using the materials and specifications, arrange equipment and make an unloading device appropriate for use with the conveyor belt in transporting salt and pepper shakers in production. See Figs. 23-4 and 23-6.

Equipment (Group of 5)

4	straight tin snips
2 pr.	scissors
1	crosscut saw
1	6″ try square
1	wooden mallet
1	medium-cut flat mill file

Supplies (Group of 5)

4 pcs.	2½″ x 6″, 24-gage sheet metal
1 btl.	rubber cement

1. Two students in Group 5 are to cut the unloading template from their Laboratory Manual, glue it to the sheet metal, and cut and bend unloading devices. See Fig. 23-6. Your teacher will tell you how many

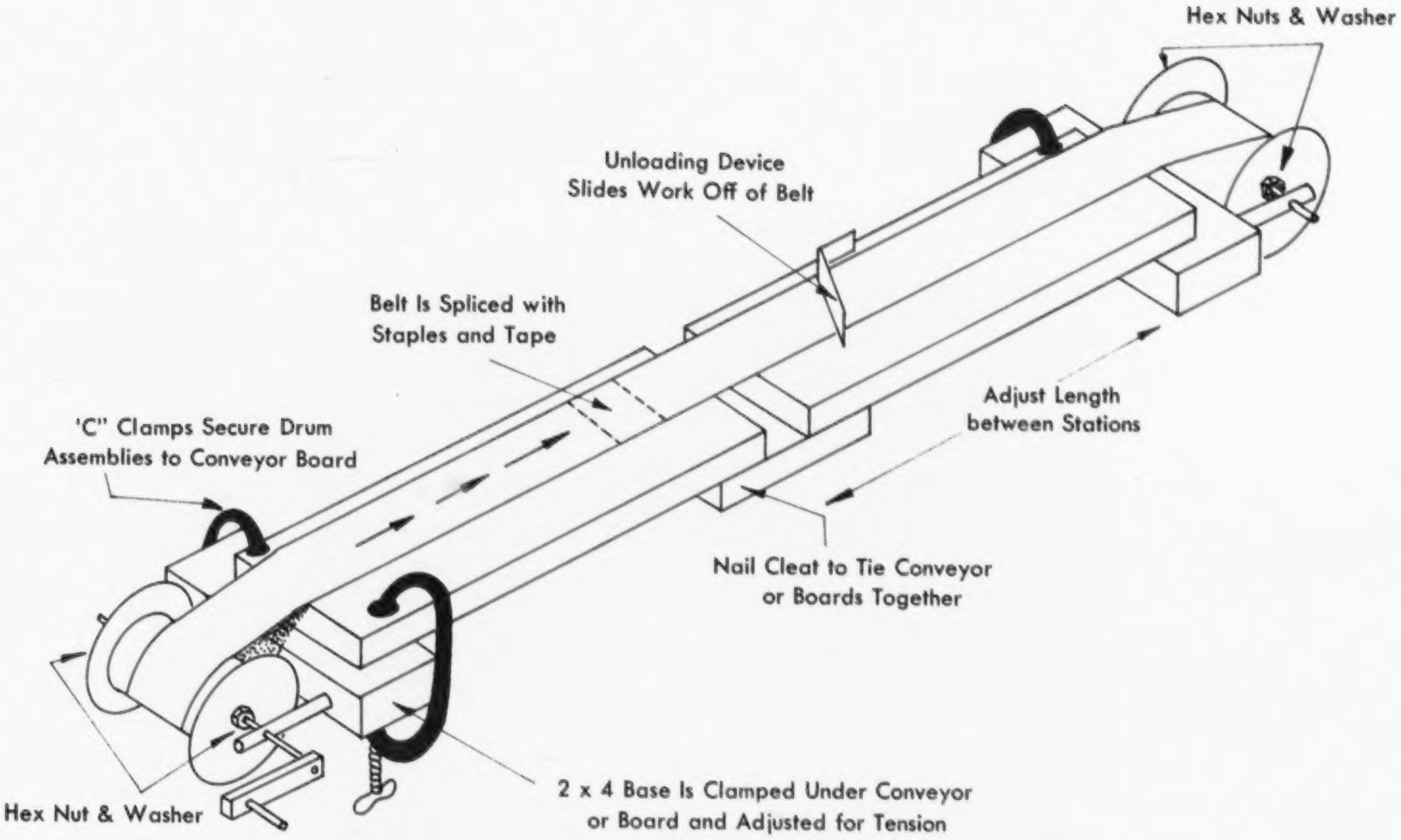

Hex Nuts & Washer
Unloading Device
Slides Work Off of Belt
Belt Is Spliced with
Staples and Tape
'C" Clamps Secure Drum
Assemblies to Conveyor Board
Adjust Length
between Stations
Nail Cleat to Tie Conveyor
or Boards Together
Hex Nut & Washer
2 x 4 Base Is Clamped Under Conveyor
or Board and Adjusted for Tension

Fig. 23-1. Conveyor Belt Setup

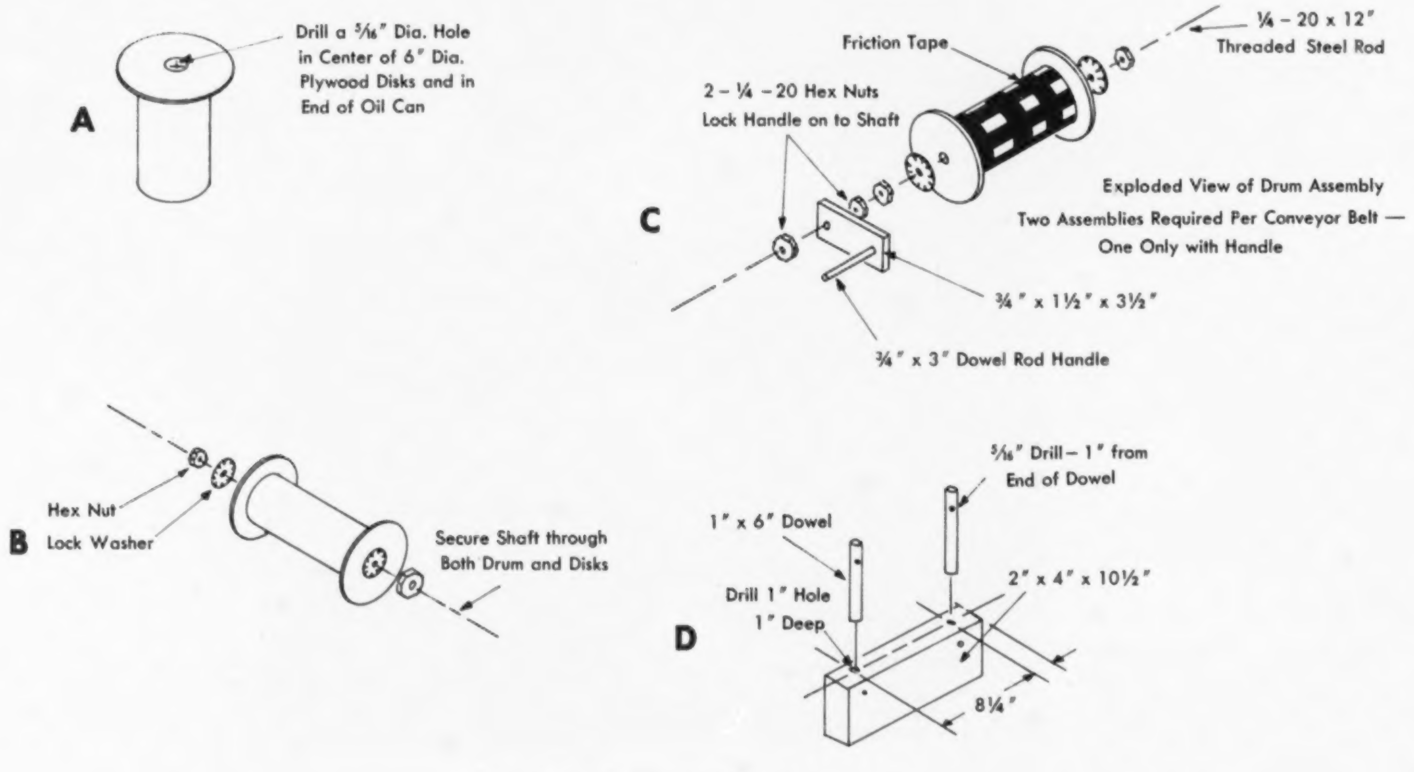

A
Drill a 5/16" Dia. Hole
in Center of 6" Dia.
Plywood Disks and in
End of Oil Can
C
Friction Tape
¼ - 20 x 12"
Threaded Steel Rod
2 - ¼ - 20 Hex Nuts
Lock Handle on to Shaft
Exploded View of Drum Assembly
Two Assemblies Required Per Conveyor Belt —
One Only with Handle
¾" x 1½" x 3½"
¾" x 3" Dowel Rod Handle
B
Hex Nut
Lock Washer
Secure Shaft through
Both Drum and Disks
D
5/16" Drill — 1" from
End of Dowel
1" x 6" Dowel
Drill 1" Hole
1" Deep
2" x 4" x 10½"
8¼"

Fig. 23-2. Conveyor Parts

unloading devices to make. File all sharp edges smooth with a flat file.

2. Install unloading devices according to the teacher's directions.
3. Three students are to follow the teacher's directions:
   a. Move machines.
   b. Line up workbenches.

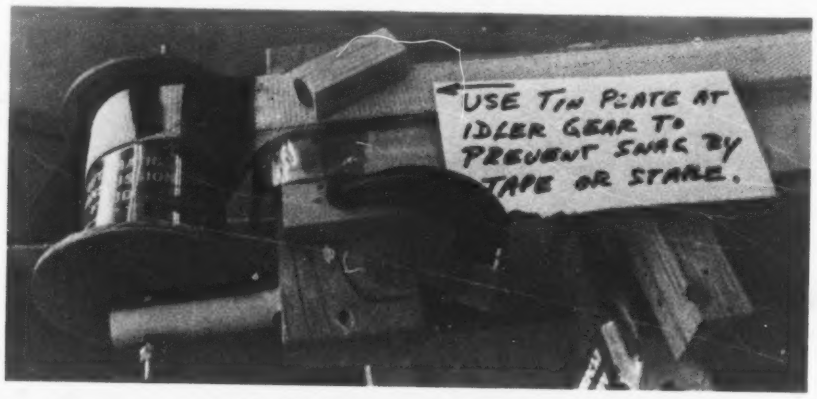

USE TIN PLATE AT
IDLER GEAR TO
PREVENT SNAG BY
TAPE OR STAPLE.

Fig. 23-3. Conveyor Assembly (Single)

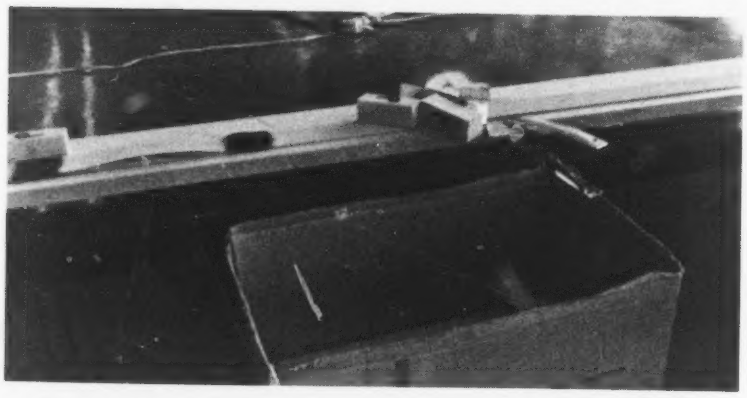


Fig. 23-4. Unloading Device Setup

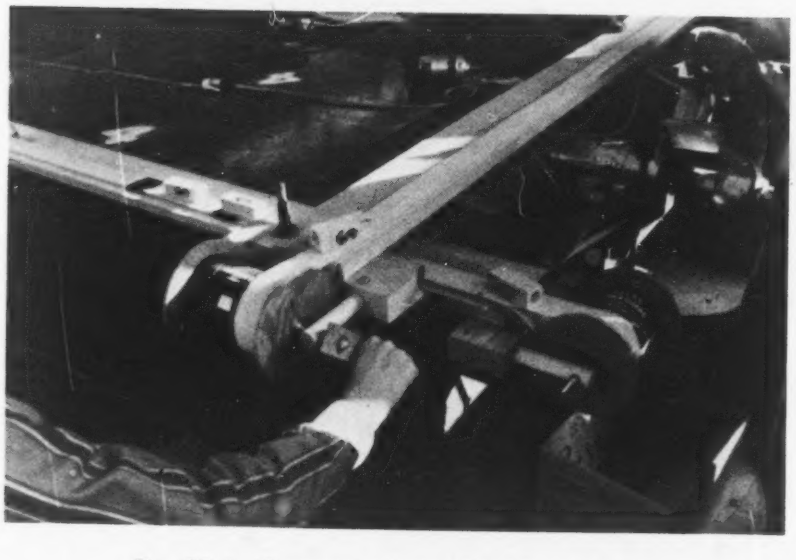


Fig. 23-5. Conveyor Assembly (Crossover)

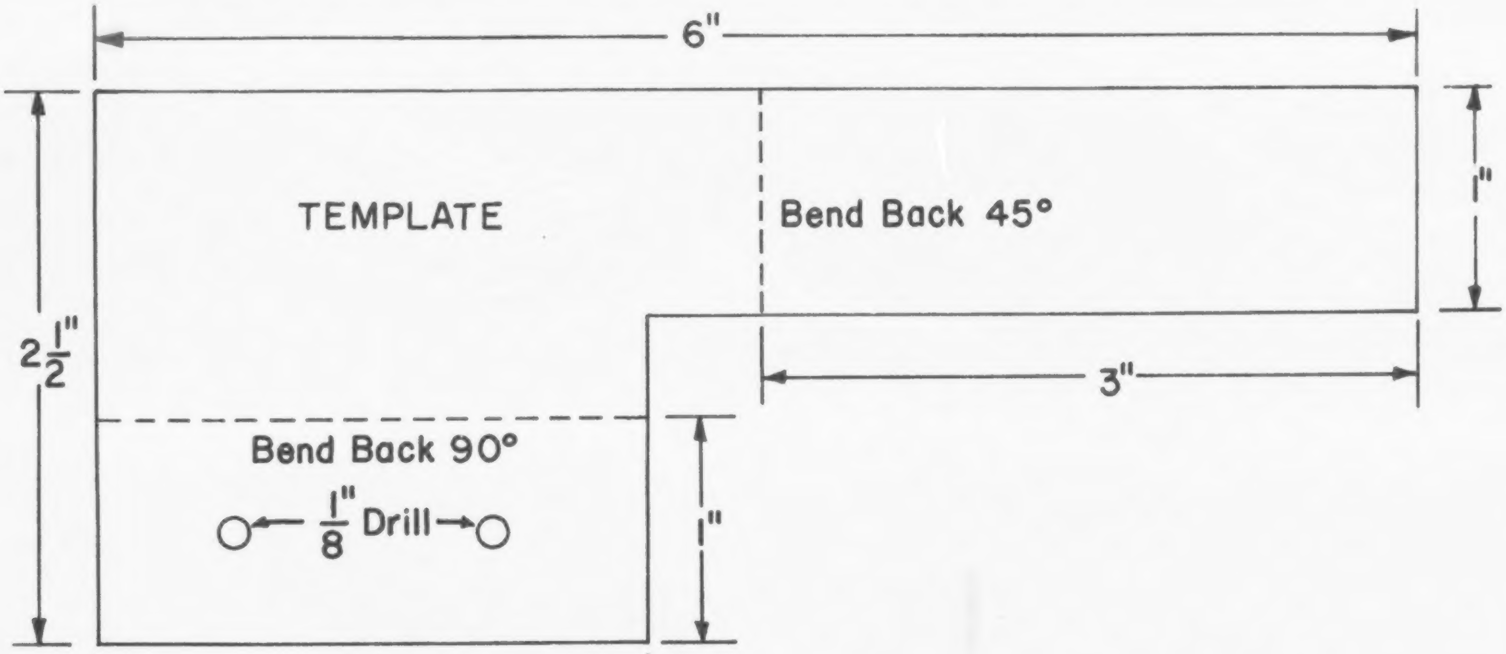

6"
TEMPLATE
Bend Back 45°
1"
$2\frac{1}{2}$"
3"
Bend Back 90°
$\frac{1}{8}$" Drill
1"
$2\frac{1}{2}$"
Tack to Conveyor Board at Appropriate Place
Webbing

Fig. 23-6. Unloading Device

ACTIVITY 24A

Tooling Up for Production

Problem

Objective

Using a completed Process Flowchart:

a. Check and adjust the production system setup for making salt and pepper shakers.
b. Conduct a trial run.
c. Fill in a Job Description Sheet.

Equipment (Class)

1	miter saw
1	conveyor system
2	drill presses with fixtures
1	¾″ Forstner bit or spade bit
1	½″ Forstner bit or spade bit
1	electric hand drill with jig
1	1⁄16″ twist drill
1	3⁄32″ twist drill
1	belt or pedestal sander with 80-grit paper
1	orbital sander with 120-grit paper
4	4″ C-clamps
3	4″ spring clamps

(This list may vary, according to equipment available.)

Supplies (Class)

1 pc.	1¼″ x 1¼″ x 7″ wood stock
2 cans	spray acrylic paint
2	#4 corks
1	dust cloth
2	cardboard boxes and newspapers (for spray-finishing stations)
25	Production Flow Charts from ACTIVITY 19
25	inspection gages

Safety

1. Keep fingers away from cutting edges.
2. Wear safety glasses.
3. Do not disturb students who are operating equipment.

Preparing to Work

1. Before the trial run, check and adjust:
   a. Machine locations,
   b. Workbench locations, and
   c. Conveyor-belt systems.
2. Your teacher will assign you to one of these tasks. (If you already have your assignment, start with Step 3.)

Conducting the Trial Run

3. Go to the work station to which you are assigned. Refer to the Production Flowchart.
4. Take your place on the production line.
5. At the teacher's signal, begin production of one salt shaker.
6. Be ready to perform the operations scheduled at your work station when the workpiece arrives there.
7. If the trial run shows any need for changing the procedures, note on your Production Flowchart all changes agreed upon.
8. Repeat Steps 4 through 6 for one pepper shaker.
9. When the block has passed your station, fill in the Job Description Sheet, Fig. 24A-1.
10. Return this sheet and the flowchart to the equipment supervisor for filing.

Fig. 24A-1. Job Description Sheet

Name: **Station Number:**

Title:

Equipment (List tools, machines, etc. needed at your work station.)

JOB DESCRIPTION

(State briefly what operations you perform at your work station.)

1.

2.

3.

4.

5.

ACTIVITY 24B, C

Tooling Up for Production

Today you will operate a production system to test the system and its product.

Problem

Objective

Using a complete production system, manufacture one salt and pepper shaker set for each class member.

Equipment (Class)

All production equipment as listed in ACTIVITY 24A

1	complete conveyor system

Supplies (Class)

Refer to the list in ACTIVITY 24A for your group.

Safety

1. Wear safety glasses if you are operating a machine.
2. Keep fingers away from cutting edges.
3. Do not disturb students who are operating machines.

Preparing to Work

1. If problems arose during the trial run in the last activity, these must be solved. Make any needed changes in the production system.
2. Check and adjust the production system, and follow your teacher's directions in arranging the equipment.

Producing Salt and Pepper Shakers

3. Go to your work station and *check* to see that you have all the *equipment and supplies* that you will need to perform your work. *Check your Job Description Sheet.*
4. *Work carefully.* A mistake could ruin the workpieces in the production system. Do not rush through your work.
5. *Observe all safety precautions.*
6. Remain at your station until the teacher calls a halt to production. When your work is finished, clean up your work area.

ACTIVITY 25

Installing Production Control Systems

Today you are to *play roles* in a production system. You will monitor and record performances. You will also compare an original production plan with one that has been modified through corrective action.

Problem 1

Objective

Using a production system as described in the Laboratory Manual: (1) *monitor,* (2) *record,* (3) *evaluate,* and (4) *propose* some form of *corrective action.*

Problems 1 and 2

Equipment (Group of 10: 2 groups per class)

1	inspection gauge
1 pr.	scissors
1	stapler
1	shoe box
1	hole punch, single

Supplies (Group of 10: 2 groups per class)

10	salt shakers
10	pepper shakers
20	#4 corks
10	3″ x 5″ tags, product name (cut from Fig. 25-11)

Planning

1. Meet with the group to which you are assigned. *Read through Problem 1* and prepare to perform as a part of the production system.
2. *Eight students will perform the production operation.* Two or more students will perform the production control functions of monitoring, recording, reporting, evaluating, and assisting in determining corrective action.

Organizing

3. *Organize the production system for assembling and packaging* salt and pepper shakers and corks. See Figs. 25-1 and 25-2.
4. *Eight students:* Go to your work stations and start production on command of your teacher. See Figs. 25-3 through 10.
5. *Two or more students:* Assume your monitoring role. Observe and record what takes place during production.

Controlling

6. Operate the production system until you complete 10 packages. *Start timing* when Department B gets its first supply of salt and pepper shakers. *Stop timing* when the 10 packages are finished.
7. After the salt and pepper shakers have been packaged, *disassemble all parts.* Stack all parts at their proper supply department.
8. Answer the following questions for your report and evaluation.

Questions

1. How long did it take to complete all 10 packages?
2. Did your production system operate smoothly, or was there a "bottleneck" that limited production? Describe the operation.

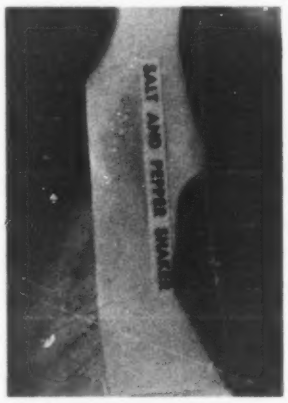

SALT AND PEPPER SHAKER

Fig. 25-6. Department C. Folding Package Tag

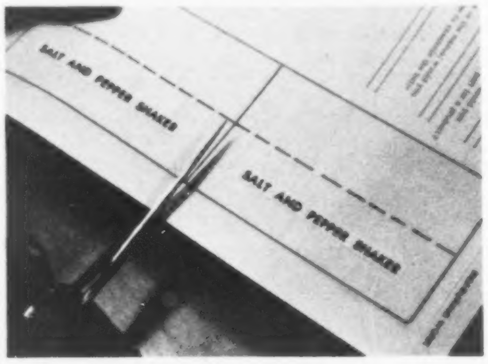

SALT AND PEPPER SHAKER
SALT AND PEPPER SHAKER

Fig. 25-5. Department C. Cutting Out Package Tag

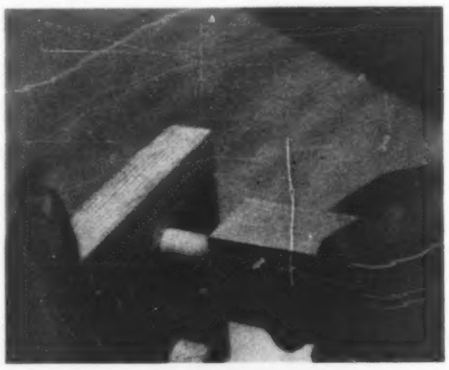


Fig. 25-4. Department B. Measuring Depth of Holes

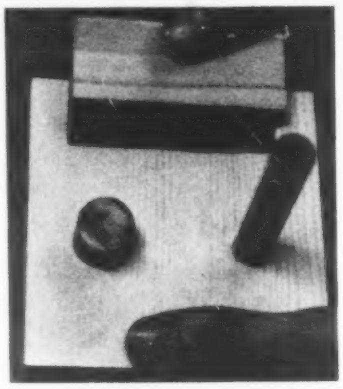


Fig. 25-3. Department B. Measuring

Fig. 25-7. Department F. Inserting Cork

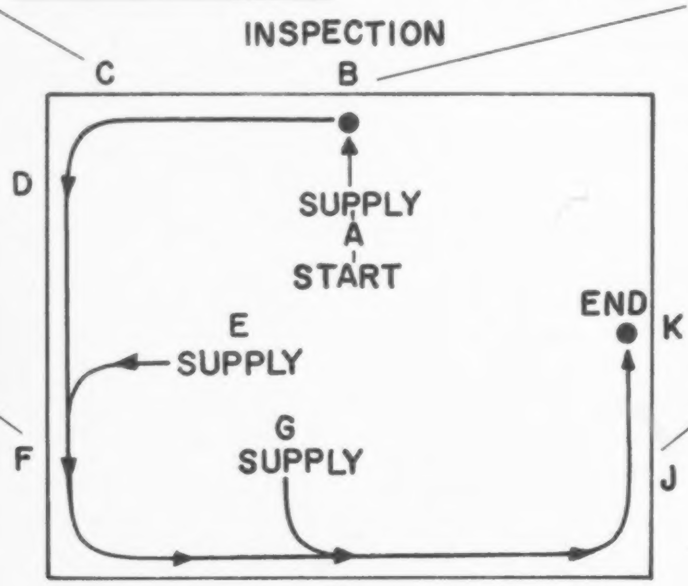

INSPECTION
C
B
D
SUPPLY
A
START
E
SUPPLY
END
K
F
G
SUPPLY
J
H
I

Fig. 25-1. Organization of the Production System

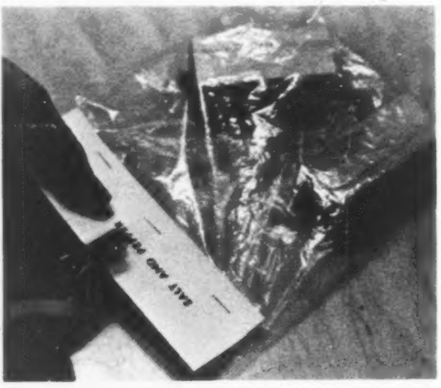

SALT AND PEPPER

Fig. 25-10. Department J. Punching Hole in Tag

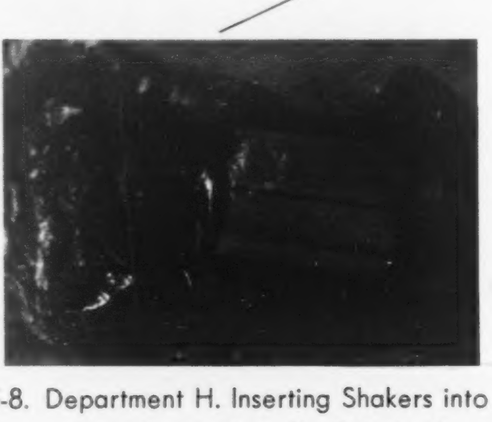


Fig. 25-8. Department H. Inserting Shakers into Bag Insert inspection slip if desired.

Fig. 25-9. Department I. Stapling Tag to the Bag

ROUTE SHEET

Salt, Pepper, Cork Assembly
Lot Size: 10 Salt, 10 Pepper, 20 Corks

Estimated Time: 2 Package/Min.

Operation	Dept.	Description	Equipment and Supplies
	A	Supply salt and pepper shakers	10 each, salt and pepper
Inspection-1	B	Inspect length of shaker and depth of hole	1 inspection gage
0 – 1	C	Cut tag	Tags from Lab. Manual, scissors
0 – 2	D	Fold tag in half	
	E	Supply corks	
0 – 3	F	Insert corks	20 corks
	G	Supply plastic bags	
0 – 4	H	Insert shakers into bags	20 bags
0 – 5	I	Staple tag on bag	Stapler
0 – 6	J	Punch hole in tag	Hole punch
0 – 8	K	Put bag into shoe box	Shoe box

Fig. 25-2. Route Sheet

3. What corrective actions would you suggest for your system?

   ____

   ____

   ____

Problem 2

Objective

Given the experiences derived from Problem 1, correct the production system and continue to monitor, record, evaluate, and propose corrective action.

Correcting

1. Sketch your changed layout on Fig. 25-1.
2. Set up the production area according to your changed layout.

Controlling

3. Operate the production system until 10 packages are completed. Do the timing as explained in Step 6 of Problem 1.
4. Monitor the production system during the production run, and observe and record what happens during production.
5. After all the salt and pepper shakers have been packaged, return all equipment and supplies to storage.
6. Answer the following questions for your report and evaluation.

Questions

1. Did you complete the packaging of the salt and pepper shakers more quickly on the second run?

   ____ Yes ____ No

2. Assuming production manufactures 2 salt and 2 pepper shakers per minute, could the packaging department keep up?

   ____ Yes ____ No

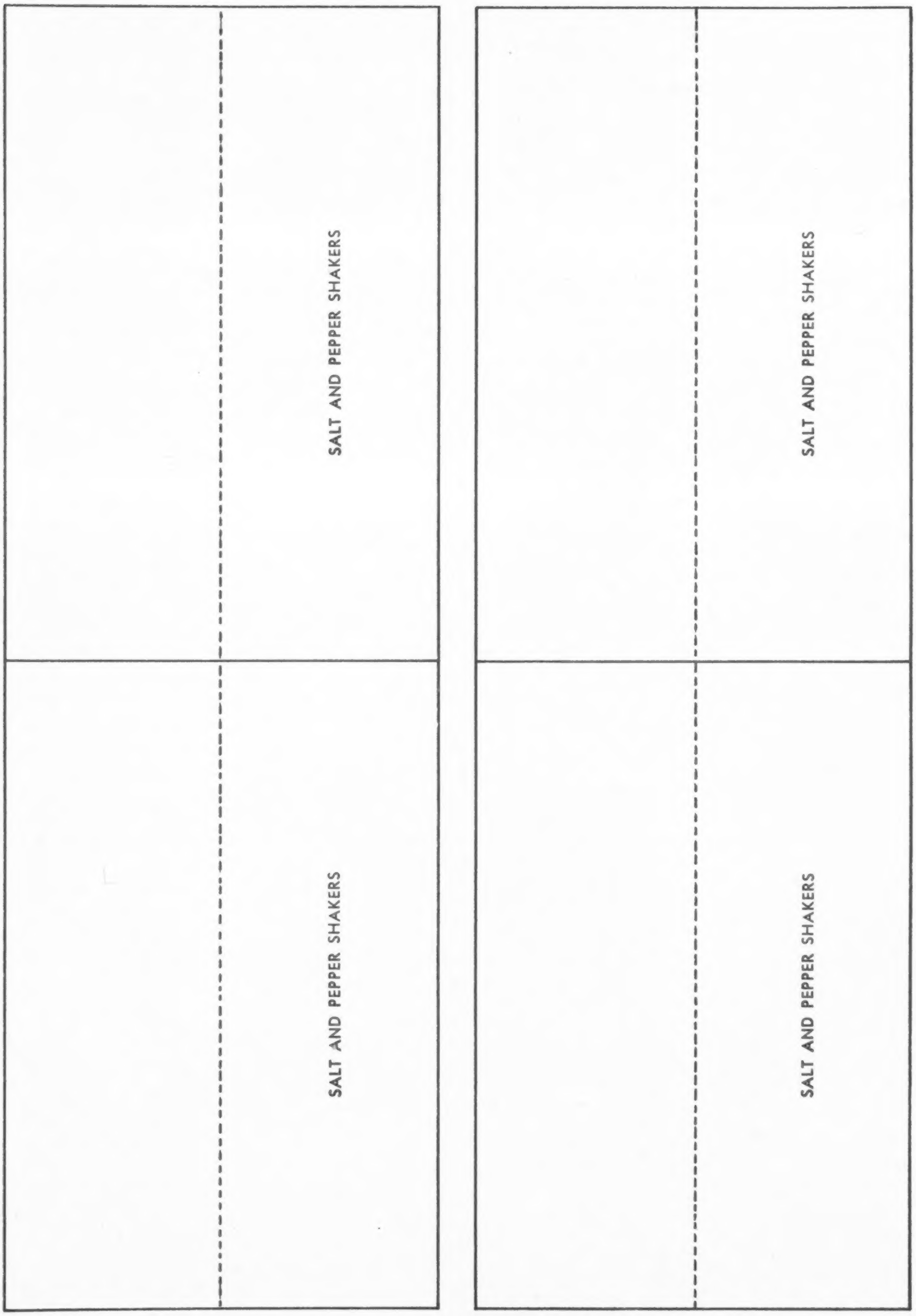

SALT AND PEPPER SHAKERS
SALT AND PEPPER SHAKERS
SALT AND PEPPER SHAKERS
SALT AND PEPPER SHAKERS

Fig. 25-3. Tags, to Be Attached to Packages

3. Did your production system operate smoothly, or was there a "bottleneck" that limited production? Describe the operation.

   ____

   ____

   ____

4. Are there any other corrective actions that you might suggest for your system?

   ____

   ____

   ____

   ____

ACTIVITY 26A

Processing Data or Information

Today you will punch letter and number data onto *Port-A-Punch* cards.

Problem

Objective

Using two Port-A-Punch cards, record the numerals *0 through 9* on one and the letters *A through Z* on the other.

Equipment (Each student: Problems 1 and 2)

1	pencil (sharp)

Supplies (Each student: Problems 1 and 2)

3	Port-A-Punch cards, IBM D 10688

Preparing to Work

1. Obtain and examine two Port-A-Punch cards. See Fig. 26A-1.

Recording Numerals 0 through 9

2. Letter the word "Numerals" and your initials *in the upper right-hand corner of one card.* See Fig. 26A-2.
3. In *Column 2* of that card, record the numeral or digit 0. Use a sharp pencil to punch out the slot in Row 0. See Fig. 26A-2.
4. In *Column 4* record the numeral 1 by punching out the slot in Row 1. See Fig. 26A-2.
5. In *Column 6* record the numeral 2 by punching out the slot in Row 2. See Fig. 26A-2.
6. Continue this process *diagonally* across the card until you reach the numeral or digit 9. You should make your last punch in Row 9 of *Column 20.*
7. With the eraser end of your pencil, remove all of the paper tabs which did not separate from the card when they were punched. When removing the tabs, *be careful not to punch out any additional holes.*
8. Check your work by laying the card over Fig. 26A-2.

> **Important**
>
> Remember that a digit (0 through 9) can be punched in any column, but the row you used for each digit is always the row used to show that digit.

Recording Letters A through Z

9. On another card letter the word "Letters" and your initials in the *upper right-hand corner.* See Fig. 26A-3.
10. To record the letter A, you must punch out two slots, *both in the same column.* Use *Column 2;* make a Zone-12 punch and a 1 numeric punch. See Fig. 26A-3.
11. In *Column 4* record the letter B by punching out the Zone-12 slot and the 2 numeric slot.
12. Continue through the letter I, which you should be coding in *Column 18* with a Zone-12 punch and a 9 numeric punch.
13. In *Columns 20 through 36* record the letters J through R. Use a Zone-11 punch and numeric punch in Rows 1 through 9.
14. Record the letter S with a Zone-0 punch and a numeric punch in Row 2. (In a Port-A-Punch alphabet, the code number 0-1 is not used.)
15. Record the letters T through Z with a Zone-0 punch and a numeric punch in Rows 3 through 9.
16. With the eraser end of your pencil, remove all of the paper tabs which did not separate from the card when they were punched.
17. Check your work by laying the card over Fig. 26A-3. Remember that a letter can be punched in any *column,* but the *rows* used for that letter are always the rows used for that letter. See Fig. 26A-4.

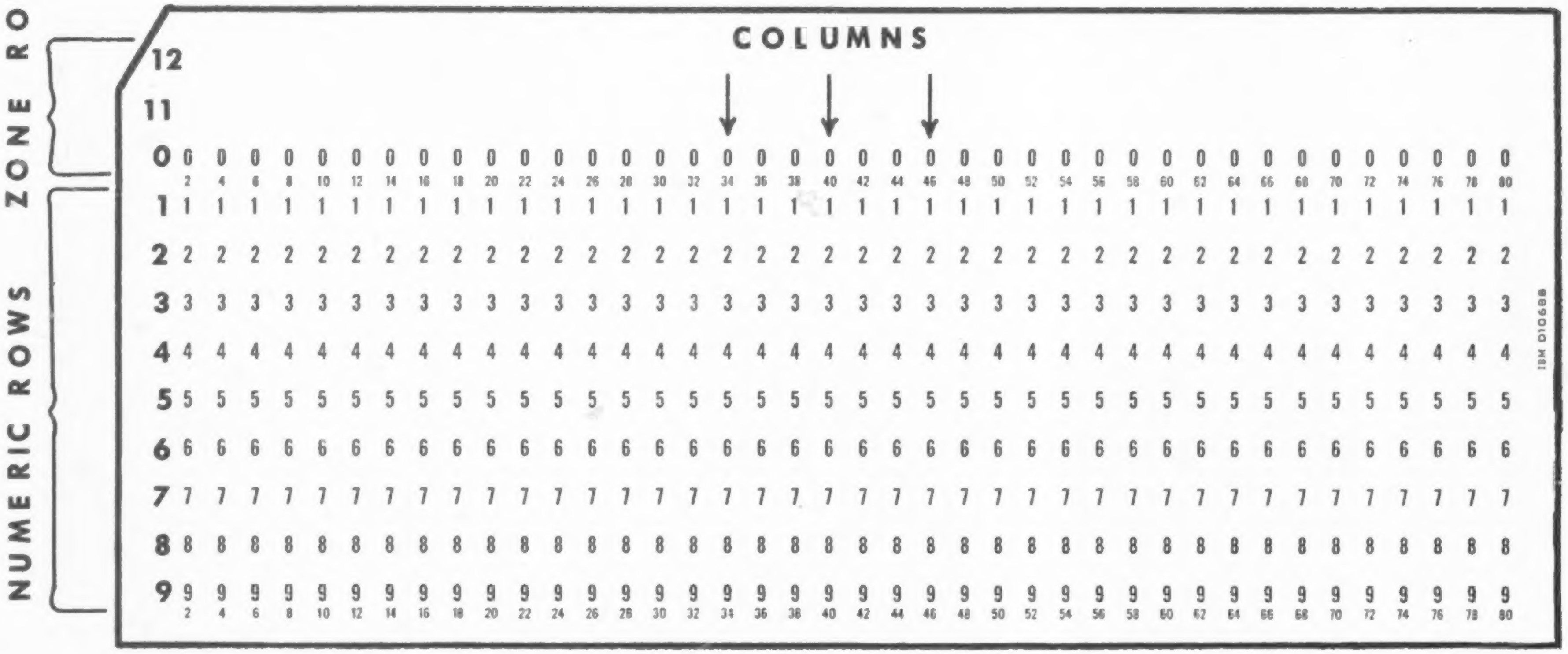

COLUMNS
ZONE ROWS
NUMERIC ROWS
12
11
0
1
2
3
4
5
6
7
8
9
IBM D10688

Fig. 26A-1. Port-A-Punch Card

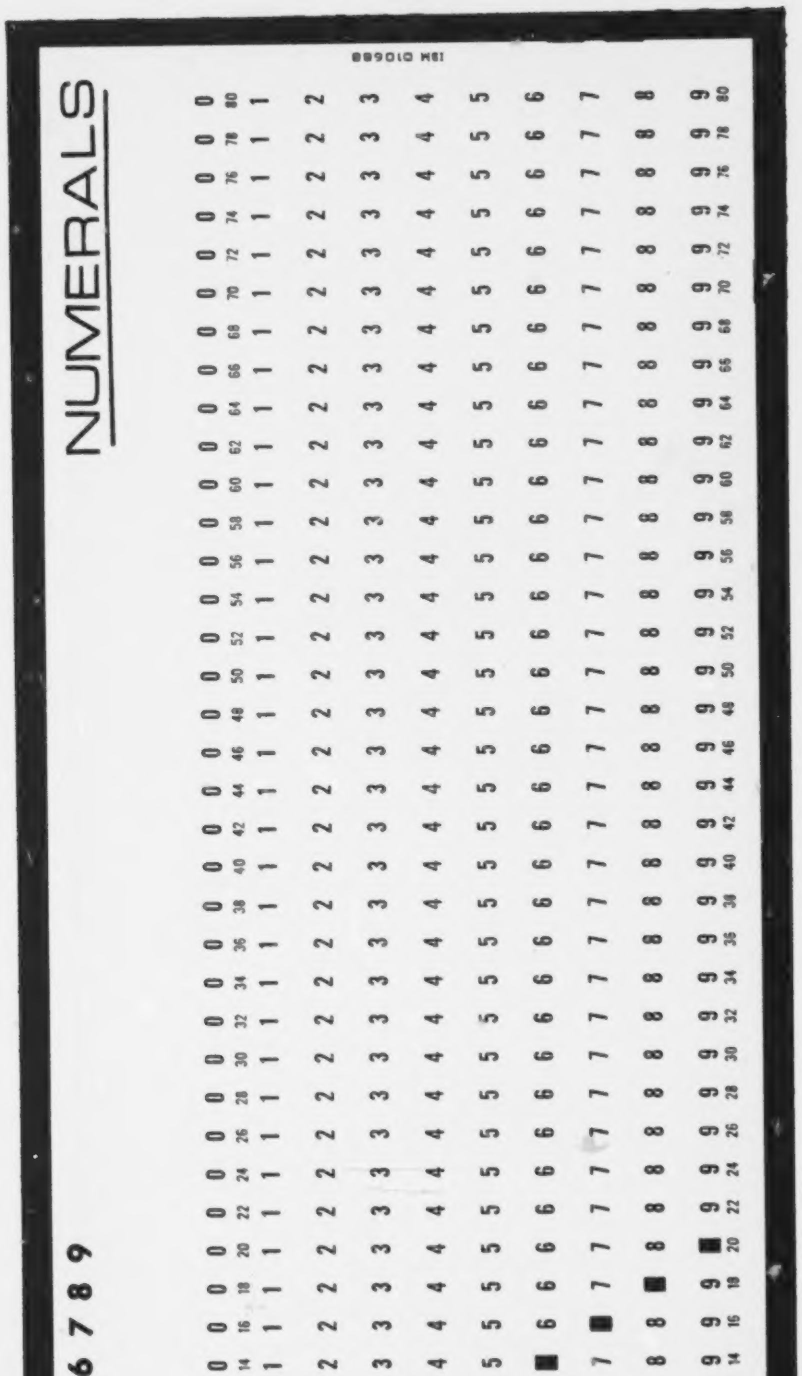

NUMERALS
0123456789
PRINTED IN U.S.A.

Fig. 26A-2. Numbers Punched in Card

Fig. 26A-4. Alphabet Code for Port-A-Punch Cards Shows zone and numeric punch for each letter.

A	12–1	J	11–1	*	. . .
B	12–2	K	11–2	S	0–2
C	12–3	L	11–3	T	0–3
D	12–4	M	11–4	U	0–4
E	12–5	N	11–5	V	0–5
F	12–6	O	11–6	W	0–6
G	12–7	P	11–7	X	0–7
H	12–8	Q	11–8	Y	0–8
I	12–9	R	11–9	Z	0–9

*In a punch-card alphabet the code number 0–1 is omitted.

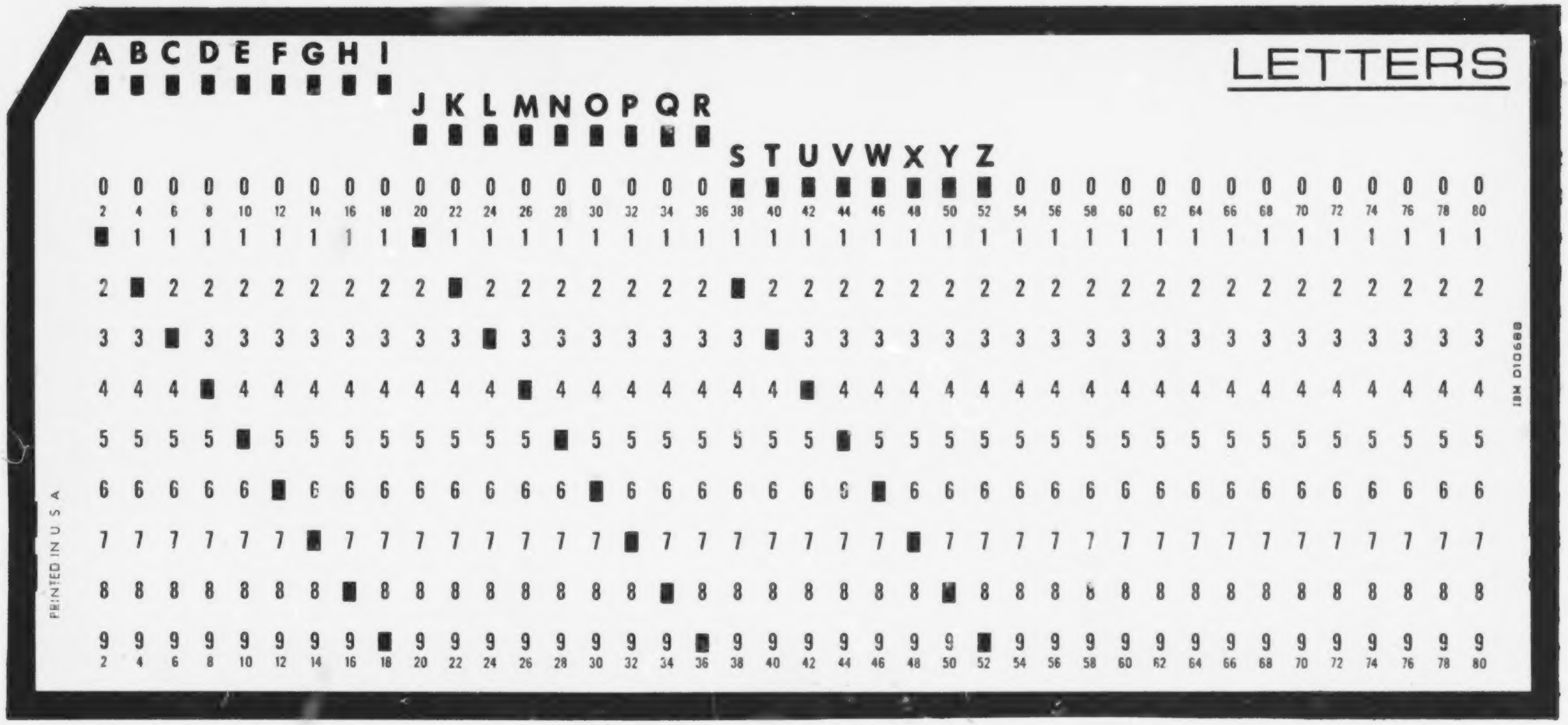

LETTERS
A B C D E F G H I
J K L M N O P Q R
S T U V W X Y Z
PRINTED IN U S A
IBM D10688

Fig. 26A-3. Letters Punched in Card

ACTIVITY 26B

Processing Data or Information

Today you will *punch your name and address* onto a Port-A-Punch card.

Problem

Objective

Using a Port-A-Punch card, record your name and address.

Equipment (Each student)
1 sharp pencil

Supplies (Each student)
1 Port-A-Punch card, IBM D 10688

Preparing to Work

1. Obtain a Port-A-Punch card.
2. *Draw light lines through Columns 22, 28, 38, 60, and 76.* See Fig. 26B-1. The first letters of words . . . or the first digit of a numeral . . . will be punched in the columns next to these lines.
3. *Letter your name and address on the bottom of the card so that one letter or digit falls in each column.* If a word is so long that some letters would cross into the next marked column, *DO NOT USE* these last letters.
4. Starting in the columns shown, letter your name and address as follows:
   Column 2: Your last name
   Column 24: The initials of your first and middle name
   Column 30: Your home street number
   Column 40: Your street name
   Column 62: Name of your city
   Column 78: Abbreviated name of your state, or first two letters

Recording the Data

5. Record each letter and digit by *punching* the correct coded *holes* with a sharp lead pencil. Remember to make *both* a *zone punch* and a *numeric punch* in the *same column for a letter;* and only *one punch for a digit.*
6. Hand the card to your teacher for checking.

Questions

1. Why do we need punch cards for recording and processing data?

2. Why do we need *two* punches to record any *one* letter of the alphabet?

3. On a Port-A-Punch card why can only 40 of the columns be punched?

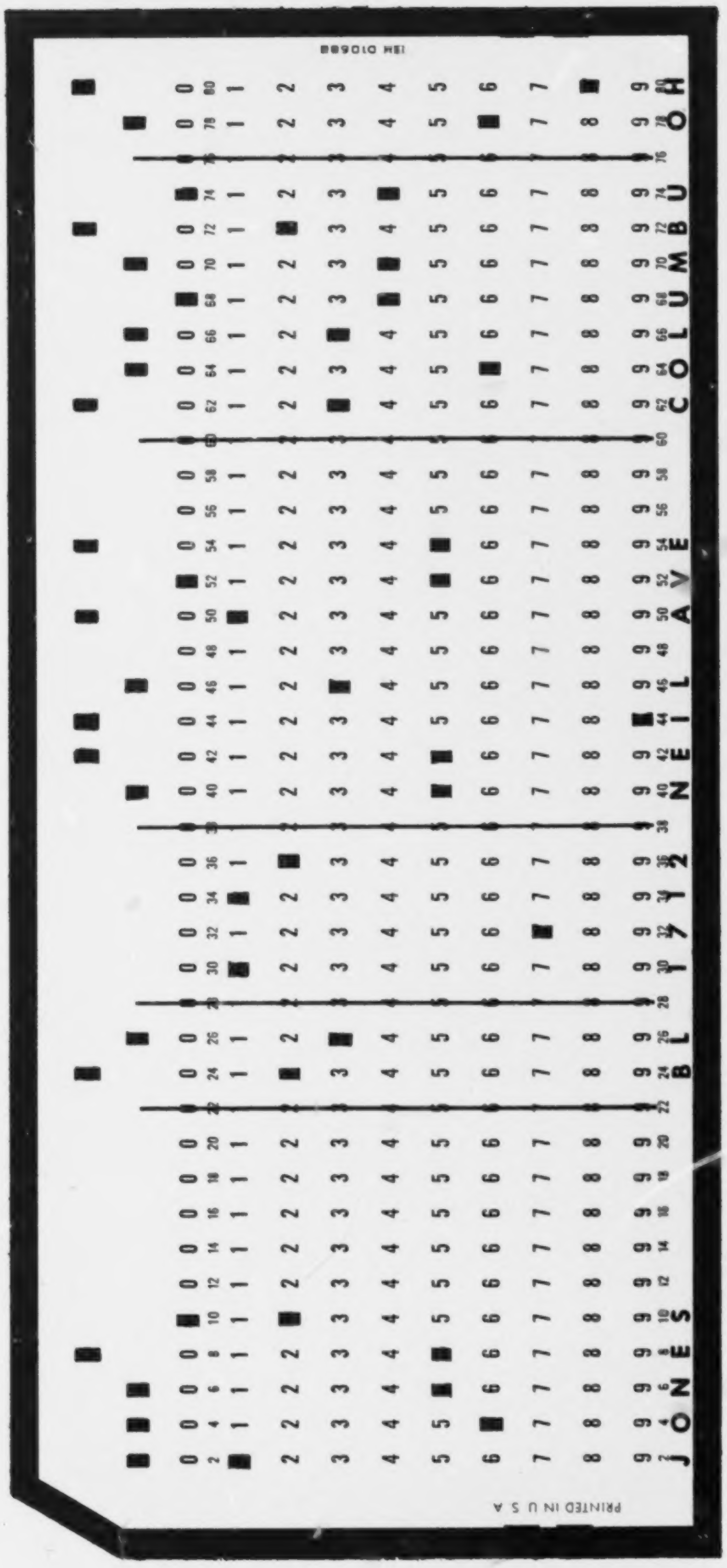


Fig. 26B-1. Port-A-Punch Card with Punched Data

ACTIVITY 27

Using the Computer

Problem

Objective

Using a branching flowchart (Fig. 27-1) and some input data, *simulate the operation of a digital computer* to solve a problem in addition.

Preparing to Work

1. On Fig. 27-2 circle the number of the row your teacher assigns to you. Copy this row of symbols very carefully onto Fig. 27-3. *Check your work before continuing.*

Processing the Data

2. Figure 27-1 is a flowchart that resembles a program used in a digital computer.
3. Find the "start" symbol on the flowchart. Follow the *arrows,* treating the input data as directed. Record all your work in Fig. 27-3.

Checking Work

4. When you have completed the laboratory activity, raise your hand so your teacher can check your work.

Questions

1. The answer to the problem shows that the flowchart was programmed to perform what operation?

____

2. In computer language the numbers 0 through 9 are called

di ________________.

3. The numbers 0 through 9 and the letters of the alphabet are all called

char ________________.

4. This flowchart imitates the operation of a

di ________________ computer.

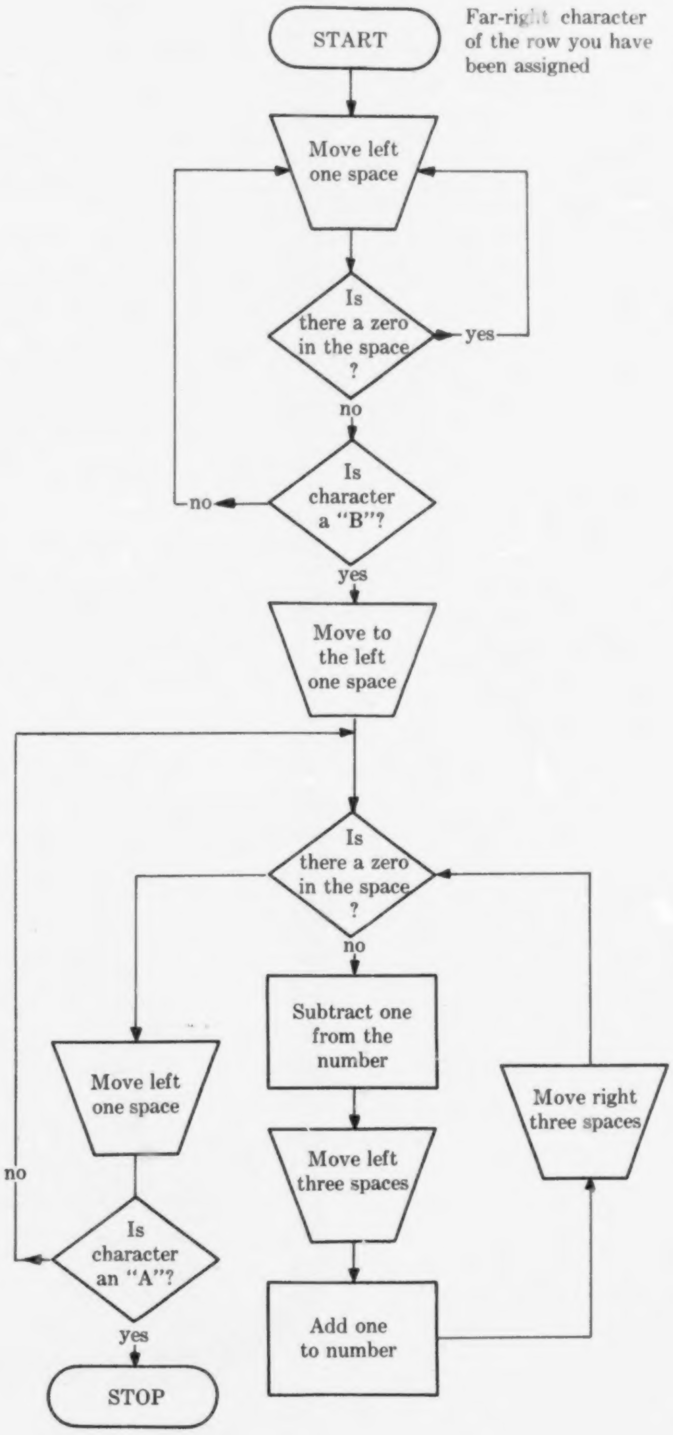

START
Far-right character of the row you have been assigned
Move left one space
Is there a zero in the space ?
yes
no
Is character a "B"?
no
yes
Move to the left one space
Is there a zero in the space ?
no
Subtract one from the number
Move left one space
Move right three spaces
Move left three spaces
no
Is character an "A"?
yes
Add one to number
STOP

Fig. 27-1. Branching Flowchart

5. Data such as these would commonly be read into a computer by a

pu ____________ ca ________________.

6. Moving in one of two alternate directions on a flowchart is called

br ______________.

Fig. 27-2. Input Data Chart

Row No.	Data (Copy one row onto Fig. 27–3.)										
1	0	0	2	1	A	2	8	B	0	0	0
2	0	1	8	A	3	1	B	0	0	0	0
3	4	6	A	0	3	B	0	0	0	0	0
4	0	1	7	A	3	2	B	0	0	0	0
5	0	0	3	8	A	1	1	B	0	0	0
6	0	0	0	4	5	A	0	4	B	0	0
7	0	0	0	0	1	6	A	3	3	B	0
8	0	0	0	4	5	A	0	4	B	0	0
9	0	0	3	7	A	1	2	B	0	0	0
10	0	1	5	A	3	4	B	0	0	0	0
11	4	4	A	0	5	B	0	0	0	0	0
12	0	3	6	A	1	3	B	0	0	0	0
13	0	0	1	4	A	3	5	B	0	0	0
14	0	0	0	4	3	A	0	6	B	0	0
15	0	0	0	0	3	5	A	1	4	B	0
16	0	1	3	A	3	6	B	0	0	0	0
17	0	0	4	2	A	0	7	B	0	0	0
18	0	0	0	3	4	A	1	5	B	0	0
19	0	0	0	0	1	2	A	3	7	B	0
20	0	0	0	4	1	A	0	8	B	0	0
21	0	0	3	3	A	1	6	B	0	0	0
22	0	1	1	A	3	8	B	0	0	0	0
23	2	2	A	2	7	B	0	0	0	0	0
24	0	3	2	A	1	7	B	0	0	0	0
25	0	0	2	3	A	2	6	B	0	0	0

Fig. 27-3. Data Processing Answer Chart

Row No.____ Effects of Flowchart Instructions	Input Data (Copy a row of symbols from Fig. 27–2.)										

Start here.

ACTIVITY 28

Manufacturing Management Technology

Today each group of students (acting as managers) will determine the procedures needed for producing a manufactured product. Group performance will be evaluated at the end of the class to determine which student groups are the *most efficient* top-level managers.

Problem 1

Objective

Using a list of manufactured products suggested by the teacher and students, choose one product which the entire class will use for today's activity.

Selecting the Product

1. The following is a list of manufactured products which can be used for today's activity:
   a. Clock
   b. First aid kit
   c. Burglar alarm
   d. Automobile emergency kit
   e. Bookends
   If you wish to add a product to this list, tell the teacher.
2. You will be asked to vote for one product only, by raising your hand. The product receiving the most votes will be used for today's activity. This product is the

   ____

Fig. 28-1. Planning Functions of Management

Definition: ______________________

FORMULATING

What are your objectives and goals for the manufacture of the product?

RESEARCHING

What research will be necessary in order to manufacture the product successfully?

DESIGNING

What functions must be performed in the design stage for the successful production of the product?

ENGINEERING

What engineering practices will be followed so that production may begin?

Problem 2

Objective

Given a manufactured product and three guide sheets, list some important procedures for planning, organizing, and controlling the manufacture of the product.

Determining Management Functions

1. As a group, list the necessary procedures for planning the manufacture of the product. Use Fig. 28-1 as a guide.
2. In Fig. 28-2 describe the organizing functions that will be needed.
3. In Fig. 28-3 describe the controlling functions that will be needed.

Scoring

4. For each procedure which is correctly listed, your group will *get one* (1) *point.* If a procedure is incorrectly listed your group *loses one* (1) *point.*
5. Your teacher will check one Laboratory Manual from each group to make sure that the management functions have been entered under the correct subheading.
6. Group foremen can add total points for the functions they have listed *after* the teacher has checked the three charts. Each foreman should have his addition checked by another group foreman.
7. Each group's final score can be recorded on the chalkboard. The high scorers will be the most efficient "managers."

Reporting

8. If time permits, the high scoring group may report their management system to the entire class.

Fig. 28-2. Organizing Functions of Management

Definition: ____________________

STRUCTURING
What kinds of work or worker functions will be required? Who will do what?

SUPPLYING
What equipment and materials will be required to manufacture the product?

Fig. 28-3. Controlling Functions of Management

Definition: ______________________

DIRECTING

What type of supervision will be necessary to manufacture the product?

MONITORING, REPORTING, CORRECTING

How will the product be inspected? Will an inventory system be established?

Who will be responsible for reporting and correcting problems in production?

ACTIVITY 29

Inputs to Manufacturing

Today you will identify some examples of inputs to manufacturing.

Problem

Objective

Given 20 pictures, *correctly identify the major input to manufacturing* that is shown in at least 16 of the 20 pictures.

Identifying Inputs

1. Carefully look at each picture and read its caption.
2. From the following list *choose an input that fits* each illustration. Choose the most obvious input, using both the picture and caption as a guide.
   - a. Natural resources
   - b. Capital
   - c. Finance
   - d. Human resources
   - e. Knowledge
3. On the line under each picture *write the answer* you chose.

Checking

4. As the teacher reads the correct answer, *circle the answers that you have wrong.*

Evaluating

5. Count the number of answers you have correct. Evaluate your performance with the following scale:

No. Correct	Evaluation
18-20	Above average
15-17	Average
12-14	Fair
11 or less	Not satisfactory

6. Correct your mistakes so your Laboratory Manual will show the right answers.

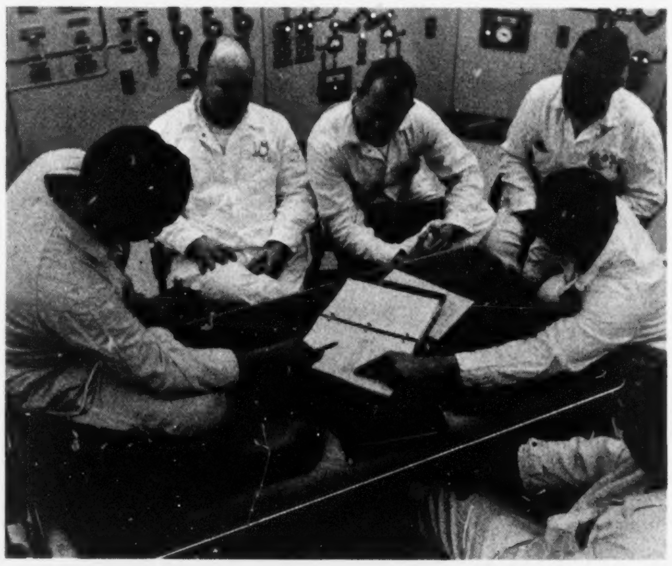


Fig. 29-1. A Research Team Must Apply . . .

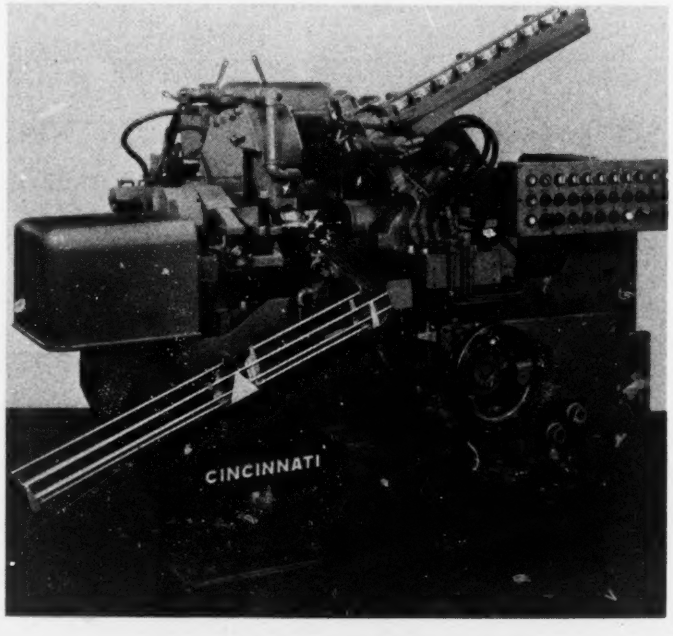


Fig. 29-2. Piston Grinder

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Fig. 29-3. Stockholders' Meeting

Fig. 29-4. Potential Labor Force

Fig. 29-5. Coal from a Mine

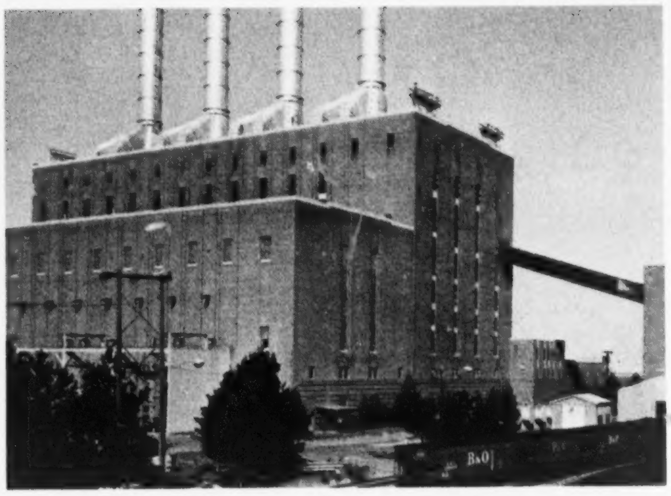

Fig. 29-6. Electricity Generated from Coal and Water

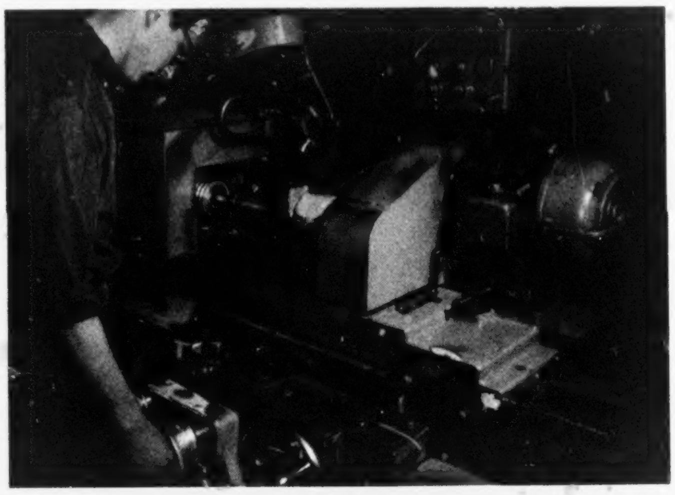

Fig. 29-7. Machine Operator

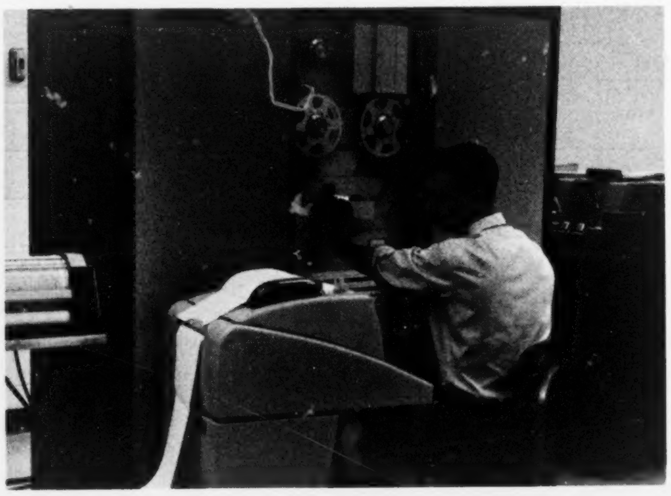

Fig. 29-8. Information or Data

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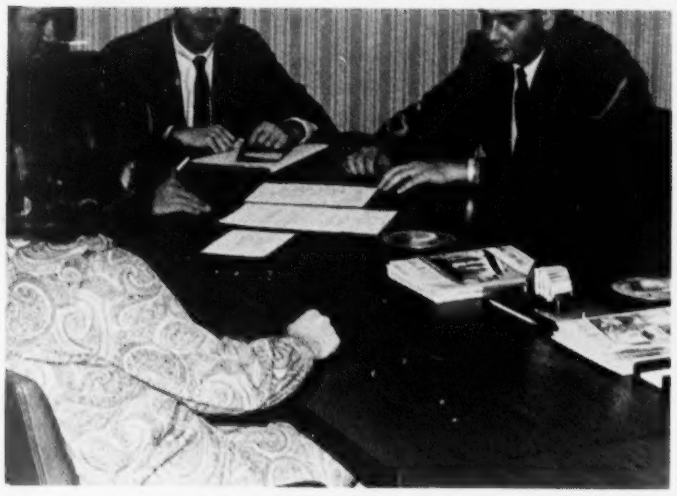

Fig. 29-9. Investment Club

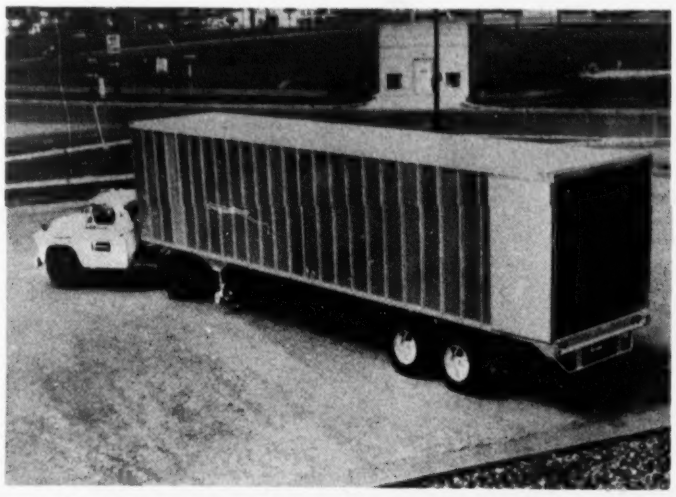

Fig. 29-10. Tractor and Trailer Rig

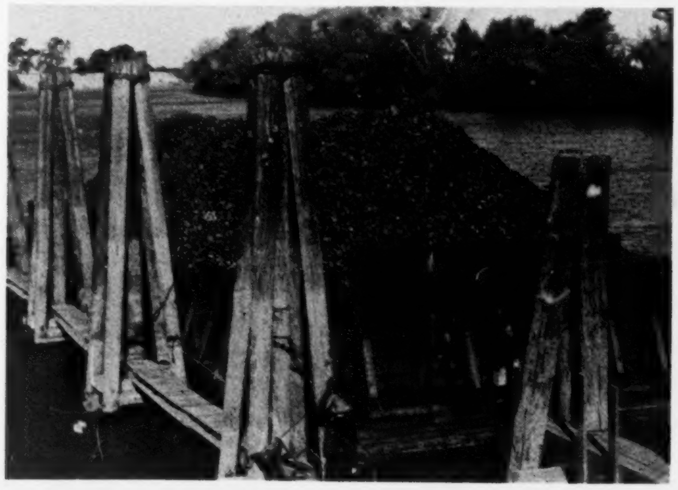

Fig. 29-11. Load of Sugar Beets

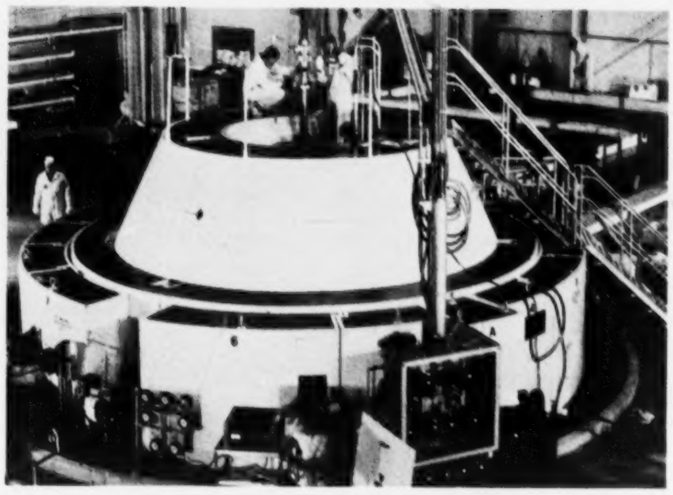

Fig. 29-12. Power from a Nuclear Reactor

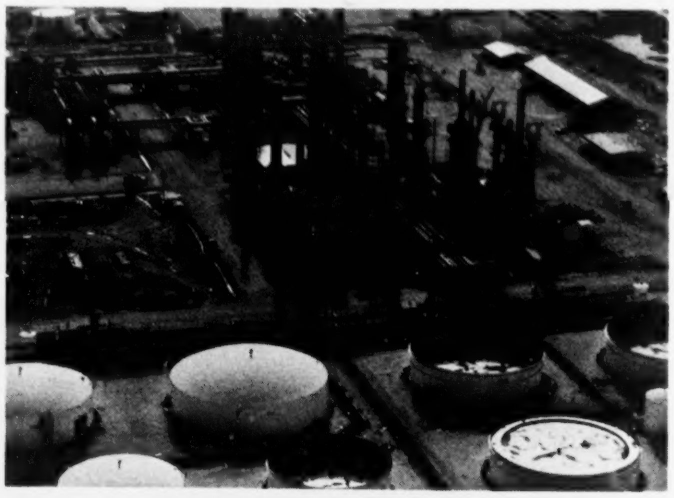

Fig. 29-13. Petroleum Refinery

Fig. 29-14. Lumber

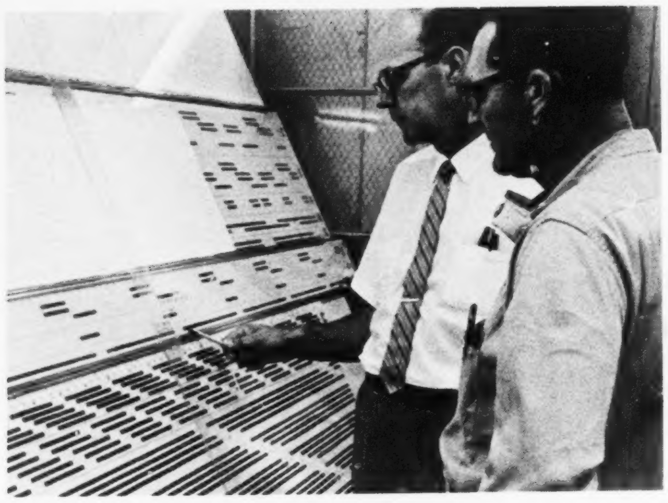

Fig. 29-15. Management Production Technology

Fig. 29-16. Potential investor

A. LINCOLN-FORD
NORWALK

Fig. 29-17. Load of Oysters

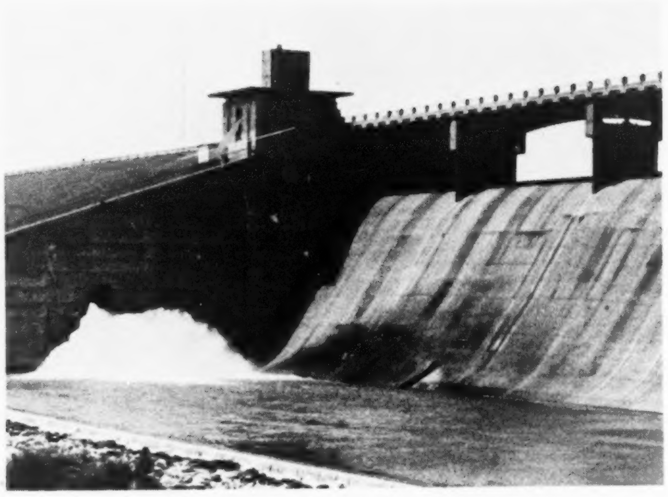

Fig. 29-18. Water Power Is a Source of . . .

Fig. 29-19. Service Representative

Fig. 29-20. Computer Equipment

ACTIVITY 30

Organization, Ownership and Profit

In getting ready to produce the next product, the class will organize itself into a *corporation*. Each student will have a role to play in the functioning of the corporation.

Problem 1

Objective

Given a list of suggested names for a new corporation, *vote for one.*

Naming the Corporation

1. Select a name that you think is suitable for your new corporation. Give this name to the teacher.
2. After the suggested names are recorded on the chalkboard, your teacher will ask you to vote for one name.
3. The name receiving the most votes will become the corporation name.

Problem 2

Objective

Given a written script, play a role in the functioning of a new corporation.

Forming a Corporation

1. Your teacher will tell you what to do in this activity.
2. You will play a role in one of these groups:
   Group 1 - Board of Directors
   Group 2 - Engineering
   Group 3 - Production
   Group 4 - Personnel
3. See Fig. 30-1, *Corporation Structure,* to see where you fit in the corporation.

Script

Group 1—Board of Directors and Investors

1. *Chairman,* Board of Directors
   "As chairman of the board of directors my first duty is to announce the name of our new corporation which is

   ______________________________.

   Our charter, issued by the State of

   ____________, permits us to offer for sale 200,000 shares of common stock. Private investors may buy the stock at $10 per share."

2. *Investor #1* (Stockholder)
   "I plan to purchase 500 shares of stock, which means I will invest $5000 in the corporation. Mr. Wallstreet, my stockbroker, recommended that I invest in the corporation after examining the consumer demand for the product to be manufactured."

3. *Investor #2* (Stockholder)
   "I have a small amount of money I wish to invest in stocks. At the present time I wish to purchase 15 shares of stock at a cost of $150. If the company is successful, I will purchase additional shares and pay for them with the stock dividends I have received."

4. *Corporation Secretary*
   "As corporation secretary, I would like to announce the four board members who were recently elected at our first stockholders' meeting. They are:

   ______________________________,

   ______________________________,

   ______________________________, and

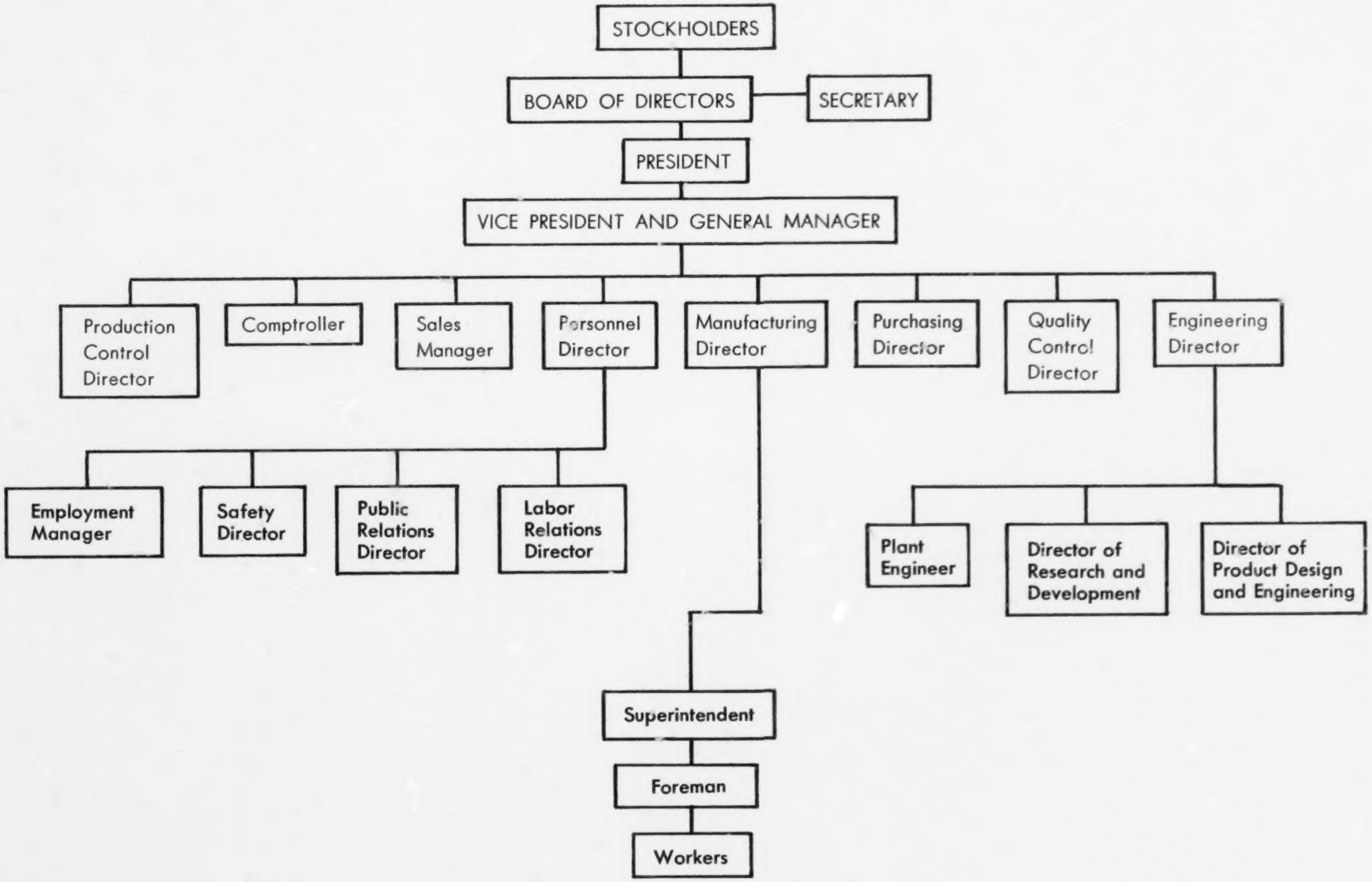
STOCKHOLDERS
BOARD OF DIRECTORS
SECRETARY
PRESIDENT
VICE PRESIDENT AND GENERAL MANAGER
Production Control Director
Comptroller
Sales Manager
Personnel Director
Manufacturing Director
Purchasing Director
Quality Control Director
Engineering Director
Employment Manager
Safety Director
Public Relations Director
Labor Relations Director
Plant Engineer
Director of Research and Development
Director of Product Design and Engineering
Superintendent
Foreman
Workers

Fig. 30-1. Corporation Structure

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____________________. All four of these board members have served as directors of other successful corporation boards."

5. *Board Member #1*
"Each share of stock owned by an investor entitles the investor to cast one vote for the chairman and other board members. Since the chairman owns 51% of all the shares in the corporation, his votes decide all questions that come before the Board of Directors. Our chairman has decided that the board will hire him to serve as president of the corporation."

6. *Board Member #2*
"As a board member, I wish to inform investors that the minimum stock purchase is 25 shares. Therefore Investor #2 will need to purchase an additional 10 shares to satisfy this minimum. The paperwork involved in a stock purchase requires that at least a minimum purchase be made."

7. *Board Member #3*
"All of the board members, including myself, have purchased stock in the corporation. Therefore any management decisions we make will be carefully thought out, since our money is involved."

8. *Board Member #4*
"We feel that the shareholders have elected a president who is well qualified to operate this corporation. I would like to have the president comment on some of his qualifications."

9. *President*
"I have been both a proprietor and a partner in the manufacture of

________________ (product). I have been involved with management, production, and personnel technology and feel well qualified to oversee the operation of this corporation. I also feel that

____________________, (name) our vice president and general manager, will be the best man for planning, organizing, and controlling the actual operations in the manufacturing plant. He has been my partner for the past five years and has proven that he can get the job done. Perhaps

____

(name) would like to comment on his plan of action."

10. *Vice President and General Manager*
"Thank you, Mr. President. My main duties will be to supervise various departments and work with department heads. I will also report our progress to the board indirectly, through the president."

Group 2—Engineering

11. *Engineering Director*
"As engineering director, my main responsibilities will be to direct and supervise product development and also oversee the engineering of the plant for efficient production of the product."

12. *Plant Engineer*
"As plant engineer my job will be to maintain the physical plant for the most efficient production. Machines and equipment break down; it will be my job to replace them. Providing a heated plant in the winter and a cool place to work in the summer is another important area that I will control. Energy, an important input to the manufacturing process, will be controlled by my staff.

13. *Director of Research and Development*
"As director of research and development, I will attempt to obtain knowledge

about our product that will allow us to manufacture it more efficiently. I will suggest the best but least expensive way of manufacturing the product."

14. *Director of Product Design and Engineering*
"The function and appearance of a product both help determine if it will sell. My job as director of product design and engineering will be to choose the most effective product design that can be manufactured at a profit."

Group 3—Production

15. *Manufacturing Director*
"As the director of manufacturing, I will control the production of the product. I will report to the vice president and general manager regarding this important job. I will work with a number of manufacturing inputs such as natural resources, human resources, and machinery (capital)."

16. *Superintendent*
"As a superintendent, I work directly with the manufacturing director. I also supervise four foremen who have employees reporting to them."

17. *Foreman*
"As a foreman, I will work with approximately 25 employees in my division. Since I am responsible for the subassemblies that are produced in my division, I will attempt to make sure the job is done right. If workers are having problems, I will instruct or assist them in order to keep the production line moving."

18. *Purchasing Director*
"As the purchasing director, I will purchase all equipment, tools, materials, and office supplies needed by the corporation. I will need to check with many people in the corporation regarding what they need or want. Before I approve payment for anything that was ordered, I must be sure that it has been received complete and undamaged."

19. *Comptroller*
"As comptroller, I will control the company payroll—the official list of workers and how much each is to be paid. I must also work with the company treasurer in keeping the books balanced."

20. *Production Control Director*
"As production control director, I will be responsible for receiving and storing materials before they are actually used in the production process. I must plan for the distribution of these materials to different parts of the plant. I will be responsible for distributing the finished product to retail stores."

21. *Quality Control Director*
"As quality control director, I will determine the standards of quality that the product must meet. I will also inspect the production to determine if the product is being manufactured according to specifications and tolerances."

22. *Sales Manager*
"As sales manager, I will be responsible for training the salesmen who sell our product. In addition, I will keep records showing how well each salesman does in selling our product."

Group 4—Personnel

23. *Personnel Director*
"As personnel director, I will be responsible for all of the activities within my departments. These activities relate to employment, medical services, insurance, recreation, public relations, safety, and training."

24. *Employment Manager*
"As employment manager, I must be

able to obtain the workers needed to manufacture our product. Before new employees are accepted, they must be tested and interviewed. After they are hired, they may require training in order to do a job efficiently. Both of these responsibilities are mine."

25. *Safety Director*
"As safety director, I must protect our workers from injury in and around the plant. I will have safety devices installed on machinery and establish safety rules for all employees."

26. *Public Relations Director*
"As public relations director, I will attempt to tell the public about our corporation and the products we manufacture. I will do this through the newspapers, and through radio and T.V. stations. I will also arrange field trips through our manufacturing plant for school groups."

27. *Labor Relations Director*
"As director of labor relations, I will work closely with the personnel director. In many cases I will work with the labor unions who represent the workers. I will try to settle disagreements between these unions and our corporation."

28. *President*
"I think all of us can see that the knowledge and cooperation of many people will be required, to make our corporation run efficiently."

Questions

1. Find your title or position on the Organization Chart, Fig. 30-1, and circle it.
2. On the Organization Chart, who is your immediate supervisor?

   ____

3. The kind of organization that usually can get the most financing is a

   ______________________________.

4. In a corporation, board members are not required to own shares of stock in the company.

   (True or False) ____________________

ACTIVITY 31

Identifying Consumer Demands

Today you will conduct a consumer survey, tabulate data from the survey, complete a class market research report, and use the report to answer questions about consumer demand for a product that you will be designing.

Problem

Objective

Using the forms provided, take part in a consumer survey to *gather data* (information) about a product the class will produce and sell, and complete a market research report.

Conducting the Consumer Survey

1. Assemble with your group of five.
2. Working individually, read the list of products written on the chalkboard and select one product. Complete the Consumer Survey Form for your selected product. See Fig. 31-1.

Tabulating Data

1. The foreman of each group is to complete the Survey Tabulation Sheet. See Fig. 31-2. *Write* in the name of the *products listed* on the chalkboard.
2. As the foreman calls out each response number for your product, raise your hand if you checked that response.
3. After all data is tabulated for your group, the *results* will be *recorded* on the *chalkboard.*
4. All the group results will be combined to get a class total for each response for each product.

Completing a Market Research Report

5. Use the data on the chalkboard to complete the statements on the Market Research Report. See Fig. 31-3.

Fig. 31-1. Consumer Survey Form

Directions: Answer each item by marking an "x" in the appropriate box.

A. Sex ☐ 1. Male
☐ 2. Female

B. Age ☐ 3. 11 yr. or under
☐ 4. 12 yr.
☐ 5. 13 yr.
☐ 6. 14-20 yr.

C. Do you presently own the product shown or a similar one?
☐ 7. Yes
☐ 8. No

D. Do you know the name of a company that makes this or a similar product?
☐ 9. Yes
☐ 10. No

E. Have you seen this or a similar product in a store?
☐ 11. Yes
☐ 12. No

F. Has this or a similar product been advertised during the last three months?
☐ 13. Yes (Go to question G.)
☐ 14. No (Go to question I.)

G. If yes, by what medium?
☐ 15. Radio
☐ 16. Television
☐ 17. Newspaper
☐ 18. Magazine
☐ 19. Other ______________

H. If you were to buy this product, where would it most likely be used?
☐ 20. At home
☐ 21. At work
☐ 22. Other ______________

I. How much would you pay for this product?
☐ 23. Less than $.25
☐ 24. $.25 — .50
☐ 25. $.50 — .75
☐ 26. $.75— 1.50
☐ 27. $1.50 — 3.00
☐ 28. More than $3.00

J. If the product were to sell for $.60 would you buy one or more?
☐ 29. Yes (Go to question N.)
☐ 30. No

K. If more than one, how many?
☐ 31. ______________

L. How often would you use this or a similar product?
☐ 32. Daily
☐ 33. Weekly
☐ 34. Monthly
☐ 35. Other ______________

M. How often would you probably replace this or a similar product?
☐ 36. Once a month
☐ 37. Once a year
☐ 38. Once in several years
☐ 39. Other ______________

Fig. 31-2. Survey Tabulation Sheet

Response	Times Checked		
1	(product)	(product)	(product)
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			

Fig. 31-3. Market Research for __________ (Product)

1. On __________ (date), a consumer survey was conducted with __________ (total of 1 and 2) consumers, of whom __________ (total of 1) were male and __________ (total of 2) were female.

2. The number of consumers surveyed, by age groups, were __________ (total of 3) 11 years old or under, __________ (total of 4) 12 years old, __________ (total of 5) 13 years old, and __________ (total of 6) 14 years or older.

3. __________ (total of 7) now own the product we are considering for production; __________ (total of 8) do not.

4. __________ (total of 9) know the name of a company that makes similar products; __________ (total of 10) did not.

5. __________ (total of 11) had seen similar products in a store; __________ (total of 12) had not.

6. __________ (total of 13) were aware of the advertising of the product; __________ (total of 14) were not.

7. Most of those who knew about a similar product were made aware by __________ (highest of 15–19) advertising.

8. Most of those surveyed would buy the product for use __________ (highest of 20–22).

9. Most of those surveyed placed a value on the product of __________ (highest of 23–28).

10. Of those surveyed, __________ (total of 29) would buy the product for $.60; __________ (total of 30) would not.

11. At $.60 the potential sale to consumers in this class is about __________ (total of 31).

12. Consumers would most likely use this product on a __________ (highest of 32–35) basis.

13. The product would have to be replaced about __________ (highest of 36–39).

ACTIVITY 32

Designing Manufactured Goods

Today you will use specifications and "thumbnail" sketches to rough out ideas for a product and develop a *refined sketch*. This product will be manufactured by your class in future activities.

Problem 1

Objective

Using the general specifications, sketch rough design ideas for the product selected by the class.

Supplies (Group of 5)
10 shts. 8½" x 11" sketch paper
1 file folder

Preparing to Work

1. Meet with your group of five and get your supplies.
2. The recorder should letter the product name on the tab of a file folder, along with the class and group number.
3. Each member of the group should print his full name on the front of the folder.

Formulating the Problem

4. You are an industrial designer working on a product design problem. You are to design a product for males between the ages of 12 and 16. National sales forecasts predict a million-dollar sales market for the product at the beginning of next summer.

Sketching Roughs

5. You are to create three rough design solutions for a product within the general limits. The teacher will supply you with the limitations.
6. Study the general limitations the teacher has listed on the chalkboard.
7. Using the general limitations as guides, select one rough design for the product. Add details and notes that help explain the product.

Problem 2

Objective

Using the general limitations and rough sketches prepared in Problem 1, develop a refined sketch of the product.

Supplies (Group of 5)
10 shts. 8½" x 11" tracing paper

Developing a Refined Sketch

1. Develop your best design into a refined sketch. You may want to trace some parts of your rough sketches, making improvements in the design as you do the tracing.

Certifying

2. Sign and date your refined sketch.
3. Your recorder will collect and file all sketches, and turn in the file folder.

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ACTIVITY 33

Making Working Drawings

Today you will make a set of working drawings for the product.

Problem

Objective

Using the drawings and information provided, draft a set of working drawings for the product, including an assembly drawing, detail drawings, dimensions and notes, and a parts list.

Equipment (Group of 5)
5 12″ rules

Supplies (Group of 5)
10 pcs. 8½″ x 11″ grid paper, ruled ¼″ x ¼″
1 set refined sketches

Drafting Working Drawings

1. Get the equipment and supplies for your group.
2. Study the refined sketches.
3. Study the specific limitations of size, shape, and material that the teacher has listed on the chalkboard.
4. The foreman will assign each student a component (part) to draw in detail, complete with dimensions and notes.
5. The foreman should make up a *Parts List* while the other students are drawing the components. See Fig. 33-1.
6. When the group is finished, the foreman will draw an assembly drawing that is complete with part numbers and names.
7. While the foreman is making the assembly drawing, each member of the group should check another member's drawing for errors.
8. When finished, return equipment and unused supplies. Clean up.

PARTS LIST

Product:____________________ DWG. No.____________

Part No.		Material	Quantity Required	Size TH x W x L
1	**Example:** base	plastic	1	1/16″ x 3″ x 7″

Fig. 33-1. Parts List from Drawing No. 305

ACTIVITY 34

Building the Production Prototype

Today you will produce the parts for two production prototypes of the product.

Problem

Objective

Using needed drawings, instructions, tools, equipment, and supplies, manufacture the parts for two production prototypes of the product.

Equipment and Supplies (Class)
As needed

General Instructions

1. The teacher will assign you to a group for today's activity.
2. Each group is responsible for obtaining and putting away the equipment and supplies which they use.
3. Each group will work on a different component part (or parts). Two of each part will be made.
4. Using masking tape, label each part produced by your group with the group number, class hours, and names of the students in your group.
5. Store the completed parts as directed by your teacher.

ACTIVITY 35

Planning Production

When an engineer plans how to produce a product, he considers all the tools and techniques that might be used. He tries to choose the best way of doing each operation. Today you will plan how to produce your product.

Problem 1

Objective

Using drawings, specifications, and operations for manufacturing your product:

a. Determine alternate ways of doing each operation.
b. Make a flowchart for some part of the production.

Supplies (Per student)

1 file folder
1 sht. paper
1 sht. carbon paper
1 component of product

Preparing to Work

1. Meet with your group. Equipment supervisor get the necessary supplies. You will be given a component. Study the component.

Analyzing Product

2. Determine what operations need to be done to make your component.
3. Determine what materials, tools, or machinery might be used for each operation. List all the practical alternatives.
4. Place a sheet of paper and carbon paper under Fig. 35-1 to make a second copy. Enter your name, class, and whether the process is fabrication or subassembly.

Making a Process Flowchart

5. Enter the operations on the *solid* lines in the column headed Operations, Inspections, and Transportation.
6. Enter any inspections that will be needed on the *dashed* lines.
7. Enter any transportation or movement from one work station to another on the *dashed* lines.
8. Study the symbols shown in Fig. 35-1. In the first column of Fig. 35-1 draw symbols to show operation, inspection, transportation, and storage. Connect the symbols to form a flowchart.
9. Enter any needed materials beside the operation where they are used.
10. Enter the tools and equipment that will be used to perform each operation, inspection, or transportation. Base your decisions on the results of ACTIVITY 34 when the class made prototype models. If in doubt, check with your teacher.
11. Firmly trace the double center line of Fig. 35-1.
12. Place the original Fig. 35-1 in your fil folder. Keep the carbon copy for use in Problem 2.

Problem 2

Objective

Using the information from Fig. 35-1, develop a master production flowchart for manufacturing the product.

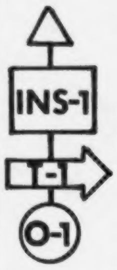
Equipment (Per class)
several pair scissors

Supplies (Per class)
1 roll transparent tape
1 pc. kraft paper, 36" x 60"

Fig. 35-1. Flowchart for One Process, with Material and Tool Lists

Component No.__________ for Product__________

Process__________ Name__________ Class__________

Symbol	Operations, Inspections, and Transportation	Materials	Tools & Equipment*
	Materials received		
	Inspected by		
	Transport to		

*To be used in the laboratory

Making Production Flowchart

1. Cut the carbon copy of Fig. 35-1 along the double line at the center. Discard the material and tool columns. Save the flowchart—the symbol and operation columns.
2. When you receive directions from your teacher, you will position your flowchart on a large piece of kraft paper and tape it in place.
3. When all the individual flowcharts are taped in place, lines will be drawn between processes with a felt tip marker to complete one master flowchart.
4. Clean up. Put equipment and supplies away.

ACTIVITY 36

Tooling Up for Production

Today you will set up the production area and conduct a trial production run.

Problem

Objective

Given flowcharts, equipment, and supplies:

a. Set up the production system for making the product.
b. Conduct a trial run.
c. Complete a Job Description Sheet. (Optional)

Equipment (Per class)
As needed

Safety

1. Keep fingers away from cutting edges.
2. Wear safety glasses.
3. Do not disturb students who are operating equipment.

Preparing to Work

1. Before the trial run, the following tasks must be performed:
   a. Line up workbenches.
   b. Set up equipment, conveyor system, and supplies at work stations.
2. Your teacher will assign you to one of these tasks. (If this has been done already, start with Step 3.)

Conducting the Trial Run

3. Identify the work station to which you are assigned. Refer to the master flowchart from ACTIVITY 35.
4. Obtain the process flowchart that you will need, and take your place on the production line. Check to see that you have the tools or supplies you will need.
5. At the teacher's signal, begin production.
6. Be ready to perform the operations scheduled at your work station when the workpiece arrives there.
7. If the trial run discloses any need for changing the procedures, note on *your* process flowchart all changes agreed upon.
8. If there is time after the workpiece has passed your station, fill in the Job Description Sheet, Fig. 36-1.
9. Return this sheet and the flowchart for filing.

Fig. 36-1. Job Description Sheet

Name: **Station Number:**

Title:

Equipment (List tools, machines, etc. needed at your station.)

____

____

____

____

____

JOB DESCRIPTION

(State briefly what operations you perform at your work station.)

1. ______________________________
____
2. ______________________________
____
3. ______________________________
____
4. ______________________________
____
5. ______________________________
____

ACTIVITY 37

Operating Quality Control Systems

Today's activity deals with *parts that match or fit*. Its purpose is to help you understand what a quality control system does, and why it is important to any production system.

Problem

Objective

Given the problem of producing interchangeable parts for a product and the production planning experience, develop the most needed gages and quality control devices for use on the production line.

Equipment (Group of 5)
As needed

Supplies
As needed, scrap wood and metal

Preparing to Work

1. Work in your regular groups.
2. Examine components that fit together or look at two of the same components. Measure the parts and compare these measurements to another part. Are they the same size or different?

Selecting Quality Control Devices

3. Decide what quality control devices need to be made. Decide which dimensions can be measured with a rule or some other measuring gage.

Drawing the Devices

4. Look at Figs. 37-1 to 37-6 and select a device that can be used best with your component.
5. Make a sketch of the device and dimension it.
6. Draw a circle around the dimension number that the device must check. This is the (X) dimension as in Figs. 37-1, 37-2, 37-3, and 37-6.

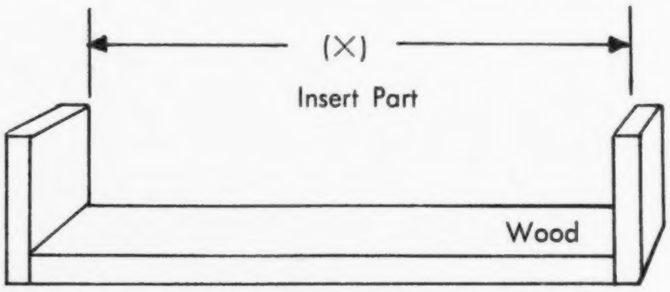


Fig. 37-1. Go-No Go Gage for Quality Control

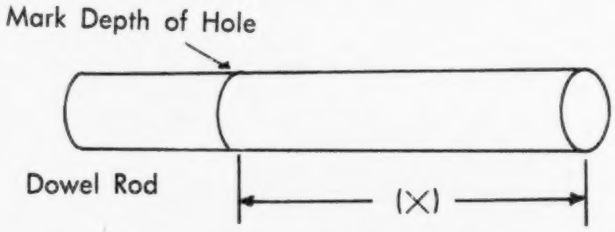


Fig. 37-2. Quality Control for Depth of Hole

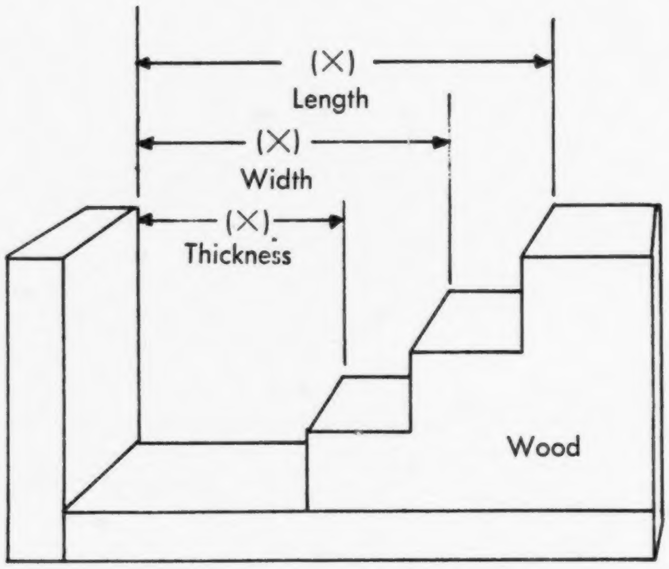


Fig. 37-3. Go-No Go Gage for Quality Control

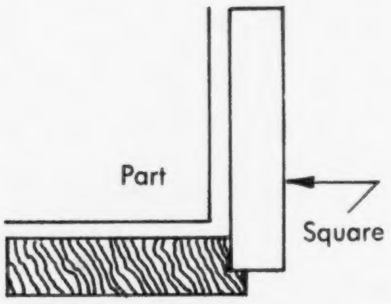

Part
Square

Fig. 37-4. Quality Control for Checking Square Corners

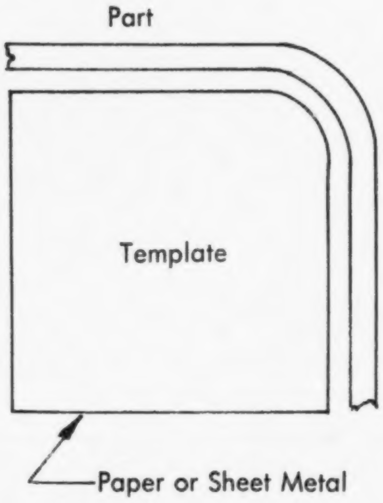

Part
Template
Paper or Sheet Metal

Fig. 37-5. Quality Control for Checking Round Corners

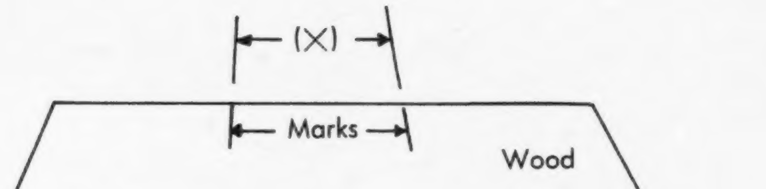

(X)
Marks
Wood
Line up with Edge of Part

Fig. 37-6. Quality Control for Checking the Distance between Holes

Making the Device

7. The equipment supervisor should get the necessary equipment and supplies.
8. The foreman should supervise the making of the device and check the (X) dimension. It must be *very accurate.*
9. Mark the device with a label that explains its use. Include the part number that it checks.
   Examples:
   a. *Part 2:* depth of hole gage
   b. *Part 4:* corner template
   c. *Part 1:* T x W x L go-no go gage
10. Clean up. Store the gages according to the teacher's instructions.

ACTIVITY 38

Measuring Work

Today you will find the standard processing time for the components of the product.

Problem
Shearing Blanks

Objective

Using needed equipment, supplies, and specifications for a set of operations, *perform and time the operations for each component of the product.*

Equipment (Group of 5)

1	watch with second hand
	equipment as needed

Supplies (Group of 5)

1 set	drawings for product
1 pc.	8½″ x 11″ paper
1	Operation Sheet from ACTIVITY 35
	material as needed

Preparing to Work

1. Get your group's equipment and supplies. Take them to your work station.
2. The timekeeper copies the operations for your component on Fig. 38-1.
3. Set up the equipment for performing the operations for your component.
4. Four students are to work together doing the necessary operations. Follow the drawings and your operation sheet.

Timing Work Processes

5. The timekeeper is to time the activity and record the total time for the operations. In timing operations, do not include setup time.
6. Production workers should clean up the work area and return equipment and supplies to storage.
7. The timekeeper should complete the arithmetic for the processing time. Complete items A-E of Fig. 38-1.

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Fig. 38-1. Time Study Observation Chart for Making Component No. ________ by Group No. ________ (Fill in blanks.)

	Processing Time for Operations									
Operator	0. EXAMPLE Shearing Blanks	1.	2.	3.	4.	5.	6.	7.	8.	
Student 1										
Student 2										
Student 3										
Student 4										
Sum (Add observed times.)										

A. The time needed to complete all the above processing is the *cycle time.* Add the row of averaged times, and enter the cycle time here.

B. To provide for time lost due to fatigue or other personal reasons, an extra *allowance time* is added. Find 20% of the cycle time. Write it here. →

C. Add *cycle time* and *allowance time* to find *standard time* for the process. →

D. Provide transfer time by adding 5 seconds between each process. →

E. Total Processing Time for Component No. ________ is →

ACTIVITY 39

Estimating Cost

Today you will estimate the total production cost of the product.

Problem

Objective

Using cost estimate charts and needed data, compute the total production cost of a selected product.

Computing Labor Costs

1. Your production plans call for several processes. Figure 39-1 shows the hourly wages of the various production workers who perform these jobs. The average of these wages is $3.00 per hour, or $.05 per minute. This 5-cent-per-minute labor cost has been entered in Fig. 39-2, *Column A*.
2. In the last activity you computed the total production time, in minutes, for each product unit. Enter this figure in *Column B* of Fig. 39-2.
3. Multiply A × B to obtain the labor cost per product. Enter your answer in *Column C*.

Computing Material Cost

4. Your teacher will give you the cost of the material for each component. Record these costs for each component in Fig. 39-3. Add these costs and record the total cost of materials.

Estimating Total Cost

5. Enter the total cost of materials in Fig. 39-3.
6. Enter the total cost of labor in Fig. 39-3.
7. Estimate the cost of overhead, using the general rule that overhead will equal the sum of the materials cost plus the labor cost. Enter this figure in Fig. 39-3.
8. Add the column of figures (cost of materials + labor + overhead + profit). Enter this total in Fig. 39-3 as the total cost of one product unit.

Fig. 39-1. Wage Data for Production Workers

Worker	Hourly Wage
Shear operator	$3.10
Drill press operator	3.10
Bench worker	2.70
Box and pan brake operator	3.10

Fig. 39-2. Labor Cost Estimate Chart

A Labor Cost per Minute	B Total Time per Product Unit	A x B = C Labor Cost per Product
$ .05		

Fig. 39-3. Total Cost Estimate for One Product Unit

Total Cost of Materials	$
Total Cost of Labor	
Estimated Overhead (taken as the sum of materials + labor)	
Profit (cost of dividends)	.25
Total Cost of One Product Unit	

ACTIVITY 40

Hiring and Training

Today you will play one of two roles. Some of you will be *job applicants* while others will be *personnel directors.*

Problem 1

Objective

Given an employment application form, *complete the form as indicated and compete for a job.*

Preparing to Work

1. Meet with your group foreman.
2. The foreman will appoint one student in your group to be the personnel director.
3. The other four students in your group will be adults who are applying for the job shown in Fig. 40-1.

Recruiting

4. The personnel director will ask each job applicant to fill out the Employment Application Form in his Laboratory Manual. See Fig. 40-2.
5. Applicants: remember that for this activity you are young adults. *You must assume* that you have finished high school and have some work experience when you fill out the job application form.
6. The personnel director will study all the completed forms for his group and decide which applicant will best fit the job vacancy. His decision will be based on the job requirements described in the requisition form, Fig. 40-3.
7. When your group completes Problem 1, wait in your work area until the other groups are finished.

PRODUCT REPAIRMAN

Large company has opening in Service Department for experienced product repairman. Must be high school graduate with 2 years experience. Excellent working conditions. Wages are $3.00 per hr. to start. Apply in person to Personnel Director, Triangle Company, 1712 Neil Avenue.

An Equal Opportunity Employer

Fig. 40-1. Job Advertisement

Problem 2

Objective

Given several job applicants, help recommend the person *best qualified* for the job opening.

Preparing for Interviewing

1. Arrange your seating as your teacher instructs you to do.
2. One group's personnel director will go to the location designated by the teacher, taking with him the job applicant whom he chose as being best qualified.

Interviewing

3. The personnel director will quickly tell the class *why* he thought this applicant was the best in his group.
4. The personnel director will interview the applicant for one to two minutes, *asking questions* about his background and experience.
5. The personnel director and the applicant are to return to their seats with the class.
6. Repeat Steps 2-5 until all groups have participated in the interview.

Selecting the Best Applicant

7. Ask those applicants who were interviewed to leave the room.
8. *The class will act as a production man-*

Fig. 40-2. Employment Application

Name		Date	
Address		Birth Date	Male ☐ Female ☐
Street City State Zip Code		Student Class No.	Home Phone
Kind of Work Desired		Wage Expected	
High School Graduate? ☐Yes ☐No	Trade School Graduate? ☐Yes ☐No	Name of School	
U.S. Citizen? ☐Yes ☐No	Personal Statistics Body Height ′ ″	Weight	
No. of Days Absent from Work in Last Year Due to Sickness		Do You Mind Working Overtime? ☐Yes ☐No	
WORK EXPERIENCE (Paperboy, grass cutting, salesman, etc.) Employer & Address	Kind of Work	Wage Received	#Months at This Job
APPLICANT-DO NOT WRITE BELOW THIS LINE			
Remarks by Interviewer:			

agement group, to recommend hiring the applicant whom they think is best qualified for the job vacancy. The teacher will conduct a brief discussion if there is time, and then ask the group members to vote for the best qualified applicant.

Inducting

9. Have the applicants return to the room and inform them who was recommended for the job and why.

Questions

1. Was the *classified ad* in the local newspaper an attempt to recruit a new worker or to find one within the plant who wished to transfer to the vacant job?

____

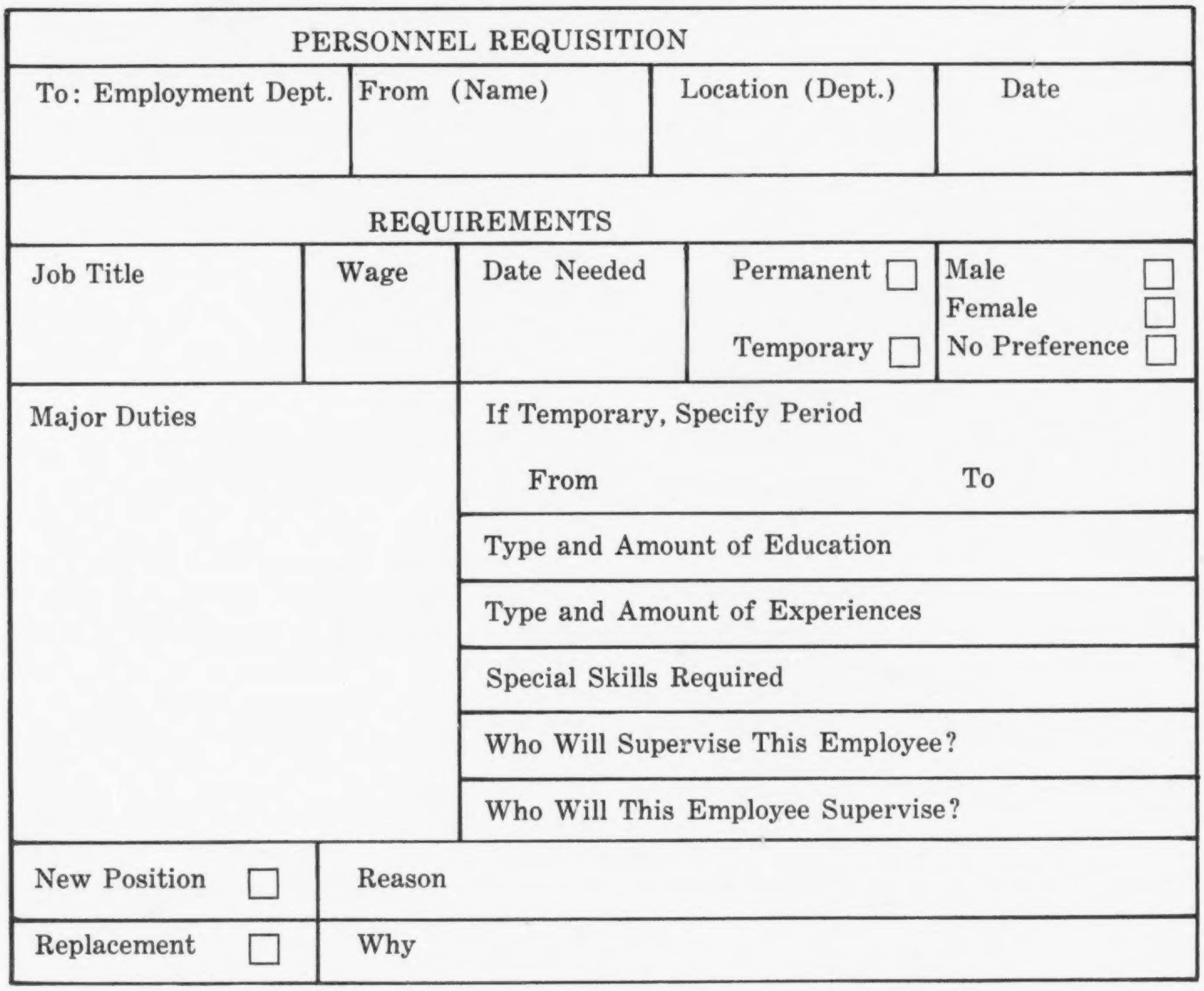
2. Do you think that there was enough information on the personnel requisition form so that the personnel director could choose the right worker for the job?

____ Yes ____ No

3. Did the interviews bring out any information about the job applicants that was not shown on their application forms?

____ Yes ____ No

Fig. 40-3. Requisition Form



PERSONNEL REQUISITION				
To: Employment Dept.	From (Name)	Location (Dept.)	Date	
REQUIREMENTS				
Job Title	Wage	Date Needed	Permanent ☐ Temporary ☐	Male ☐ Female ☐ No Preference ☐
Major Duties	If Temporary, Specify Period From To			
	Type and Amount of Education			
	Type and Amount of Experiences			
	Special Skills Required			
	Who Will Supervise This Employee?			
	Who Will This Employee Supervise?			
New Position ☐	Reason			
Replacement ☐	Why			

4. If you answered "yes" to Question 3, explain your answer.

5. The application form and the interview were used in this activity for choosing the best qualified applicant for the job. What *other* methods are sometimes used?

ACTIVITY 41

Manufacturing Personnel Technology

Today's activity involves learning about the five kinds of personnel practices and their subdivisions. At the end of the activity we will determine which group is the most efficient in personnel management.

Problem

Objective

Given twelve pictures, identify the basic kind of personnel practice and the subdivision or specific practice shown in each picture.

Preparing to Work

1. Your group foreman should appoint a recorder for your group.

Identifying Practices

2. Look at each picture and read the caption. See Figs. 41-1 to 41-12.
3. Discuss the situation within your group. Use Fig. 41-13 to help you identify:
   a. Which main kind of personnel practice is shown.
   b. The subdivision or part of that practice that is shown.

Recording Group Decisions

4. The recorder should enter the decisions of the group in his book under "a" and "b". The other students in each group should also record group decisions in their Laboratory Manual.
5. *Two points* will be given for "a" answers that are correct. *One point* will be given for "b" answers that are correct.

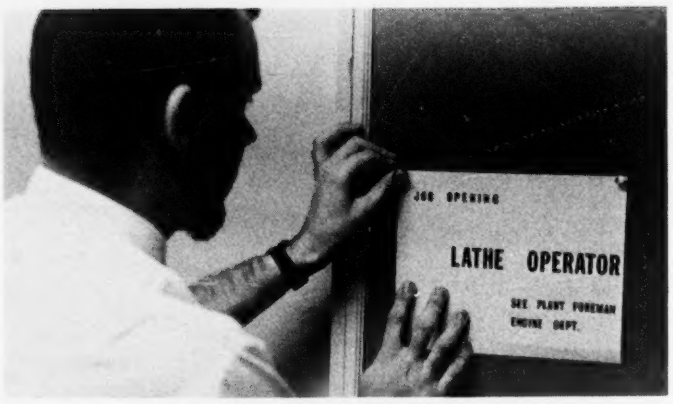


Fig. 41-1. Posting a Job Opening

A. ____________________

B. ____________________

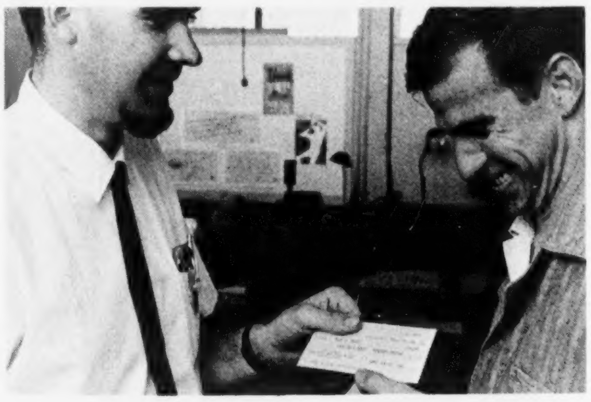


Fig. 41-2. Receiving a Weekly Paycheck

A. ____________________

B. ____________________

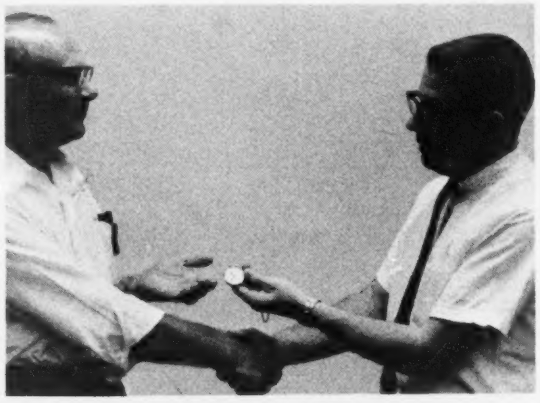


Fig. 41-3. Receiving a Watch for His Many Years with the Firm

A. ____________________

B. ____________________

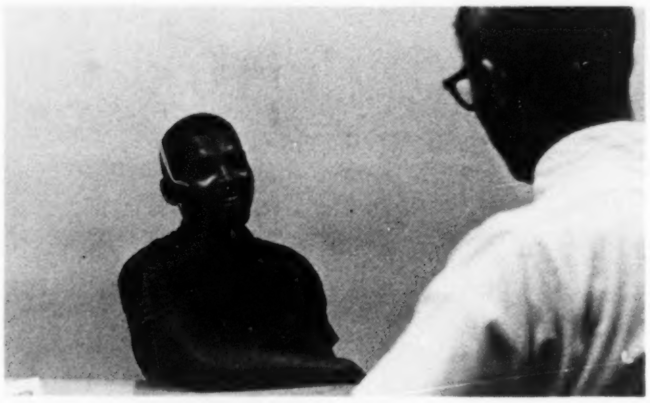


Fig. 41-4. Interviewing a Job Applicant

A. ______________________________

B. ______________________________

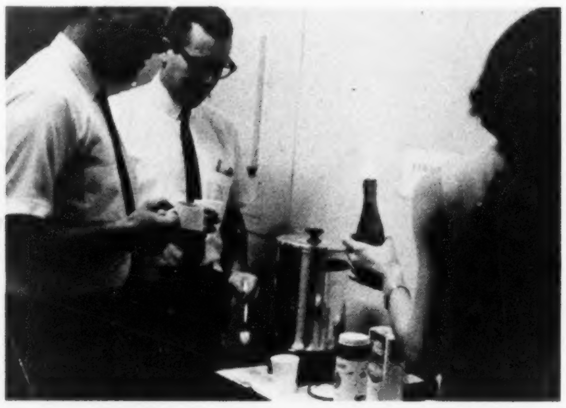


Fig. 41-5. The Morning Coffee Break

A. ______________________________

B. ______________________________

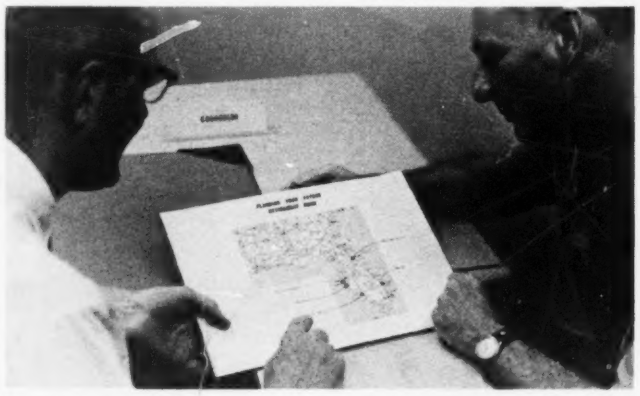


Fig. 41-6. Discussing Where to Build a Future Retirement Home

A. ______________________________

B. ______________________________

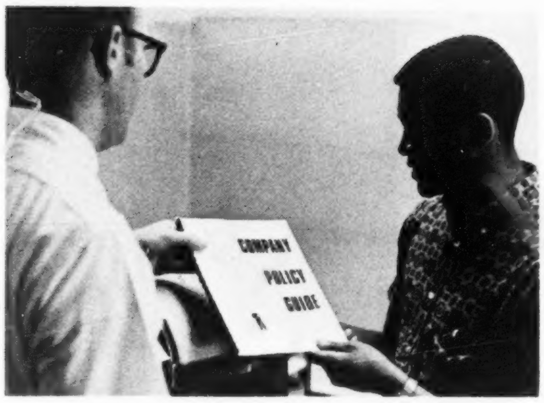


Fig. 41-7. Breaking-in a New Employee

A. ______________________________

B. ______________________________

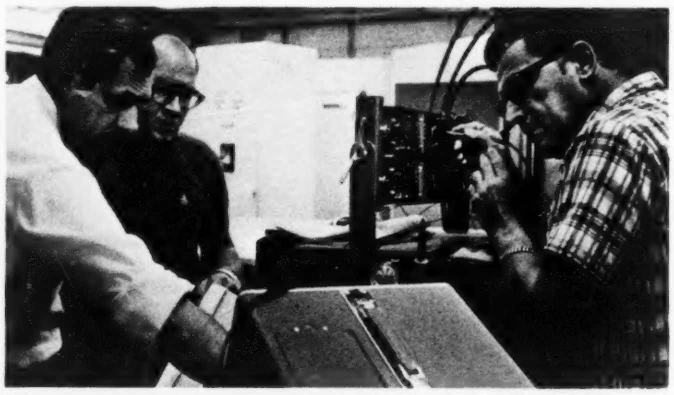


Fig. 41-8. Teaching a New Employee His Job

A. ______________________________

B. ______________________________

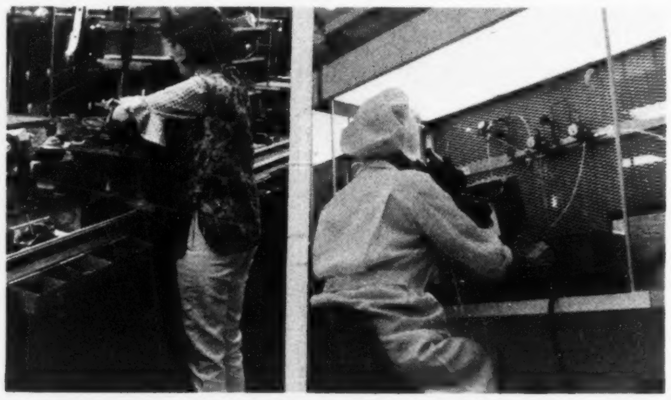


Fig. 41-9. Two Types of Plant Facilities

A. ______________________________

B. ______________________________

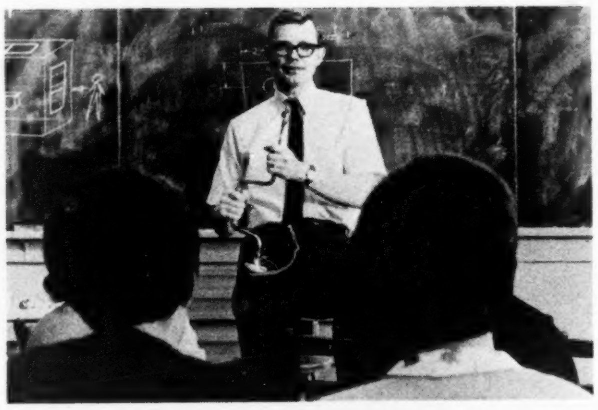


Fig. 41-10. Teaching New Employees

A. ______________________________

B. ______________________________

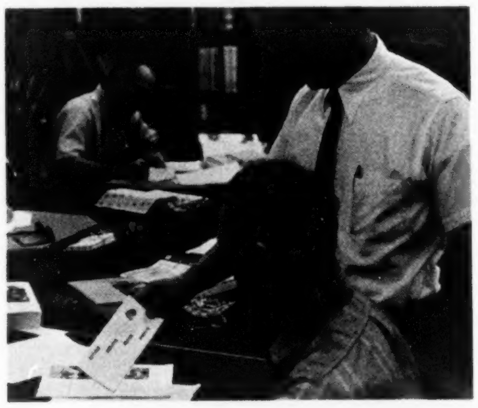


Fig. 41-12. Giving a Retired Worker a Medical Policy

A. ______________________________

B. ______________________________

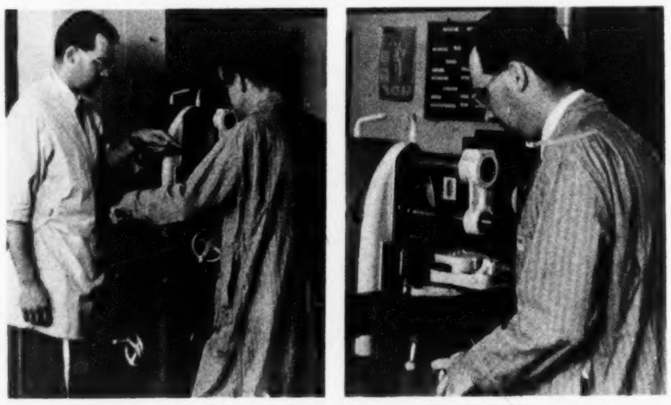


Fig. 41-11. Changing Positions (A to B)

A. ______________________________

B. ______________________________

Hiring:
- Recruiting
- Selecting
- Inducting

Training:
- On-the-job
- Other training

Working:
- Economic rewards
- Physical setting
- Social environment

Advancing:
- Promoting
- Demoting
- Discharging

Retiring:
- Counseling
- Preretirement
- Recognizing service
- Awarding fringe benefits

Fig. 41-13. Personnel Practices of Manufacturing Technology

Evaluating Group Decisions

6. Each recorder should pass his completed Laboratory Manual to another group foreman for checking.
7. Your teacher will read the correct answers.
8. Using the Tally Sheet Fig. 41-14, each group foreman should total the number of points obtained and return the Laboratory Manual to the proper group recorder. Remember, correct "a" answers receive 2 points while correct "b" answers receive 1 point.
9. Your teacher will tell the class which group of students qualified as the most efficient personnel managers.

Fig. 41-14. Tally Sheet

Group identification ____________________

Points

Number of "a" answers correct ________ x 2 = ________

Number of "b" answers correct ________ x 1 = ________

Total Points ________

Name of foreman
evaluating group performance: ____________________

ACTIVITY 42A, B, and C

Manufacturing Production Technology

Today, using the production system you have planned and organized, you will begin production of your selected product.

Problem

Objective

Using a complete production system, manufacture a required number of products.

Equipment and Supplies (Class)

As needed	
1	Production Flowchart
All	Job Description Sheets
All	Quality Control Devices
All	Working Drawings
All	Operation Sheets

Preparing to Work

1. Your teacher will review the Process Flowchart with you.
2. If the production system is not set up, follow your teacher's directions in arranging the equipment.
3. Go to your work station and review the Job Description Sheet previously prepared. Make sure all needed tools and supplies are at your work station.

Safety Precautions

1. Wear safety glasses if you are operating machines.
2. Keep fingers away from cutting edges.
3. Do not disturb students who are operating machines.

Producing Products

4. Work carefully. A mistake could ruin the workpieces in the production system. Do not rush through your work.
5. Observe all safety precautions.
6. Remain at your station until the teacher calls a halt to production. When your work is finished, clean up your work area.
7. Your teacher will advise you about cleanup and disassembling the production system.

ACTIVITY 43

Organized Labor and Collective Bargaining

Problem

Objective

Given a collective bargaining situation, arrive at a solution by following the appropriate procedure.

Situation

1. In another lesson you will work with establishing accident-prevention programs. Assume that an accident prevention program has uncovered the fact that eye protection (safety glasses, face shields, etc.) is not available for workers who must use machinery. It was also discovered that the lighting is inadequate at machinery such as the drill press and squaring shears, and therefore a worker's fingers or hand could possibly be near the cutting tools without his knowing it.
2. The union representatives argue that the company should:
   a. Provide more lighting over each piece of machinery.
   b. Supply eye protection for all workers.
3. The company representatives argue that:
   a. The lighting above the machinery is adequate, since it has been acceptable for the past five years.
   b. Eye protection should be supplied by the individual workers, since it is part of their personal equipment.
4. The union and management have not resolved their differences on the issues. The union threatens to strike if the two issues are not settled.
5. You will be assigned to a group with one of the following job titles:
   a. Local union president.
   b. Local union vice president.
   c. Company industrial relations director.
   d. Plant manager.
   e. Federal mediator.
6. You will have fifteen minutes to present arguments in the following manner:
   a. The two senior union representatives (*a* and *b* above) are to present their reasons why the company should supply better lighting and the proper eye protection.
   b. The two company representatives (*c* and *d* above) are to present their reasons why the lighting is adequate and the workers should supply their own eye protection devices.
7. If no agreement has been reached after this discussion has ended, and before the fifteen minute time limit expires, the federal mediator will summarize the arguments he has heard from both sides and have the class vote on a solution. The possible solutions are:
   a. The company will provide better lighting over machinery and proper eye protection.
   b. The union members will continue to work as in the past. The lighting will stay the same and the eye protection will be forgotten about.
   c. The company will provide better lighting and the union will provide the proper eye protection.
   d. The union will go on strike if both issues are not settled to their satisfaction.

Collective Bargaining

8. Study the situation. Then follow Steps 6 and 7 in collective bargaining for the next fifteen minutes.
9. Your group will have a few minutes at the end of the laboratory activity to present your agreement to the rest of the class. This presentation will be made by the student serving as the federal mediator.

ACTIVITY 44

Working, Advancing and Retiring

One part of manufacturing personnel technology concerns working, advancing, and retiring. Today you will act as either a worker, union steward, or management representative in solving a working problem.

Problem

Objective

Given a labor-management problem, solve it through discussion between management and union representatives.

Preparation

1. You will be assigned one of the following titles by your foreman:
   a. Worker (two needed per group).
   b. Management representatives (2 needed per group).
   c. Union steward (the safety supervisor in each group).
   d. The group *recorder* should keep notes for the steward who will use them in reporting to the class later. See Step 7.

Labor's Position

Workers and union steward will argue these points:

2. Workers from the J-H Manufacturing Corporation have met to air a complaint to their *union steward,* as follows:
   a. Production workers complain that *toxic* (poisonous) *fumes* are present in the area where certain parts are being fabricated.
   b. Although respirators and exhaust fans are present, the workers explain that the fumes are still irritating, and they are requesting 10-minute breaks every hour.

Management's Position

Management representatives will argue these points:

3. a. The management of the J-H Manufacturing Corporation states that although the fumes are present, they are a usual part of the manufacturing process.
   b. Management further states that with the exhaust and respirator (nose cover) devices present, the concentration of fumes is low enough so it will not bother the workers.
   c. Management also states that production flow would be severely hindered or stopped if the workers were given a 10-minute break every hour.
   d. Management will hire a worker to relieve other workers so they may take 10-minute breaks.

General Information

4. Present working schedule:
   Starting time: 8 a.m.
   Morning Break: 10 to 10:10 a.m.
   Lunch Break: Noon to 12:30 p.m.
   Afternoon Break: 2 to 2:15 p.m.
   Quitting Time: 4:30 p.m.

Negotiating

5. During this meeting, labor and management must *decide on a compromise* to avert (stop) a possible walkout. You will attempt to *negotiate a settlement* acceptable to both parties.

Decision

6. During the final ten minutes of the laboratory period, the *union steward* of each group will present his *group's decision* to the class. He should give reasons for the decision.

Fig. 45-1. Accident Prevention Checklist

Item	Provided?		Quality?			Inspector's Tally
	Yes	No	Good	Fair	Poor	
1. Wash facilities						
2. Lighting						
3. Water						
4. Heating						
5. Ventilation and exhaust systems						
6. Product storage						
7. Noise control						
8. Main switch shutoff						
9. Fireproof waste cans						
10. Non-slip floor areas						
11. Safety clothing						
12. Safety zones						
13. Lighting on machines						
14. Belt guards						
15. Safety glasses						
16. Marked fire exits						
17. Fire extinguishers						
18. First-aid cabinet						
19. Stock storage						
20. Fire alarm						
21. Fireproofing — hot metals area						
22. Aisle space						
23. Color coding						
24. Hand tool condition						
25. Power tool condition						
26. Posted safety rules						
27. Gas check valve						
28. Machine guards						

ACTIVITY 45

Establishing Accident Prevention Programs

Problem 1

Objective

Given a checklist of 28 items in a school laboratory relating to safety:

a. Inspect your industrial arts laboratory and show on the checklist *whether or not* your laboratory provides for the listed items.
b. Suggest corrective action.

Preparing to Work

1. Assemble with your regular group of five.

Today the safety superintendent of your group will collect and evaluate the results of all the other students' inspections, and report the findings to the teacher.

Inspecting Conditions

2. Examine all parts of the laboratory, using your Accident Prevention Checklist as a guide. See Fig. 45-1.
3. After you have completed your inspection, assemble in the seating area with the other students in your group.

Evaluating Safety

4. The safety superintendent should now tabulate and record the results of the inspection. (See Steps 6 and 7.)
5. During this time, the other four members of the group should complete *Problem 2* of this activity.
6. For each item, count the number of "Poor" quality ratings. If more than three students rated the item as poor, *the superintendent should check the last column.*

Summary (To be completed by safety superintendent.)

In an inspection of laboratory facilities, the following items were found to be of poor quality as regards safety:

____

____

____

____

The following items are not provided:

____

____

____
Safety Superintendent

Group_____

Fig. 45-2. Safety Provisions

UNSAFE CONDITIONS

_____ 1. Flying metal chips

_____ 2. Toxic vapor

_____ 3. 120° temperature

_____ 4. Oil-soaked floors

_____ 5. Handling heavy objects

_____ 6. Low pipelines

_____ 7. Aisles filled with machine stock

_____ 8. Cleaning solvent

PROTECTIVE DEVICES

a. Fireproof containers
b. Air conditioning
c. Ventilation
d. Stock-storage facilities
e. Safety hats
f. Safety glasses
g. Safety shoes
h. Non-slip floor areas

7. The superintendent should then complete the bottom part of Fig. 45-1 and take it to the teacher.
8. After all safety superintendents have turned in their reports, the class will have a chance to review all the reports and suggest ways to improve safety conditions.

Problem 2

Objective

Given a list of unsafe conditions and devices to protect workers against the conditions, match each unsafe condition with a suitable protective device.

Completing the Chart

1. On Fig. 45-2 match the unsafe conditions with the protective devices. Print a letter in the left-hand column to show each answer.

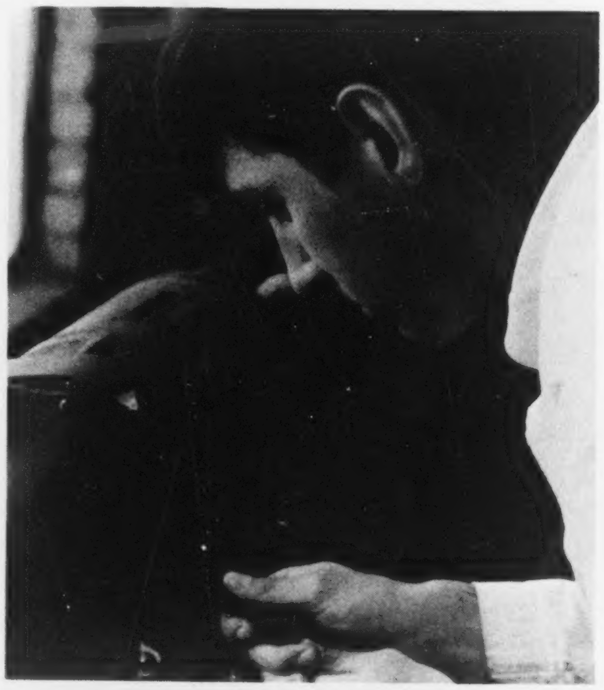


Fig. 45-3

Unsafe Condition_______________________________

Safe Condition_________________________________

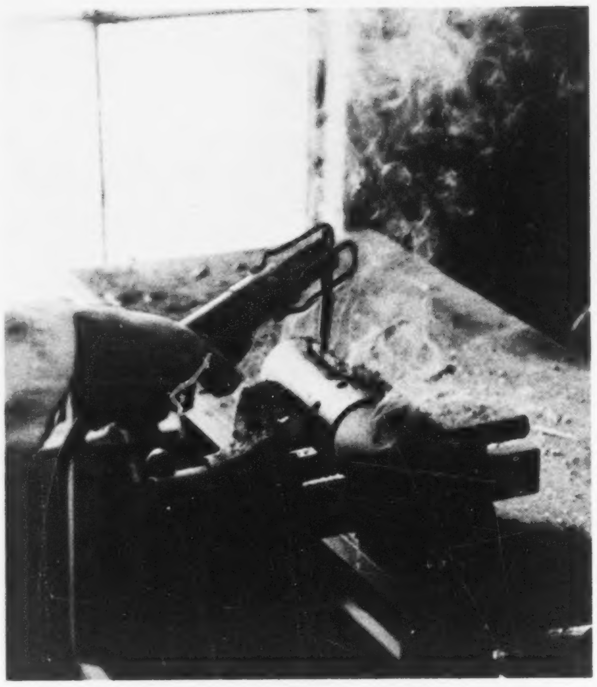


Fig. 45-4

Unsafe Condition____________________________

Safe Condition____________________________

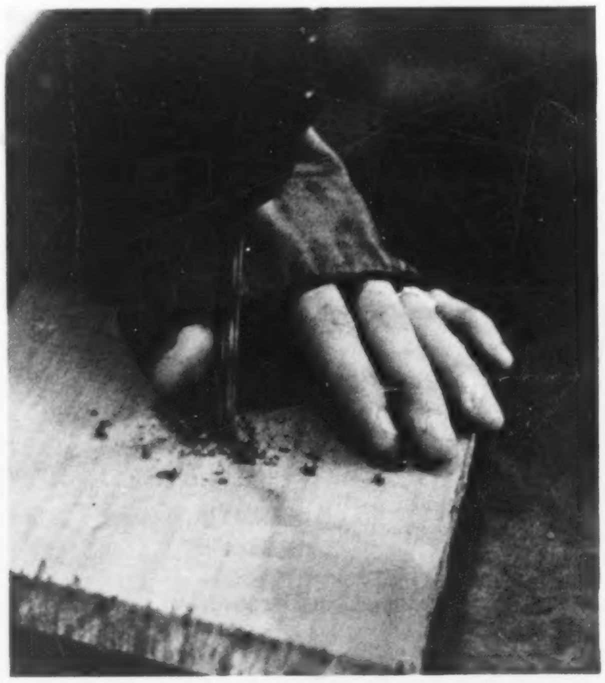


Fig. 45-5

Unsafe Condition____________________________

Safe Condition____________________________

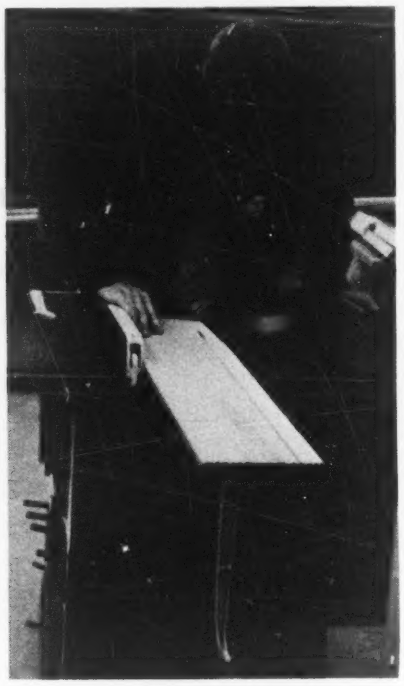


Fig. 45-6

Unsafe Condition____________________________

Safe Condition____________________________

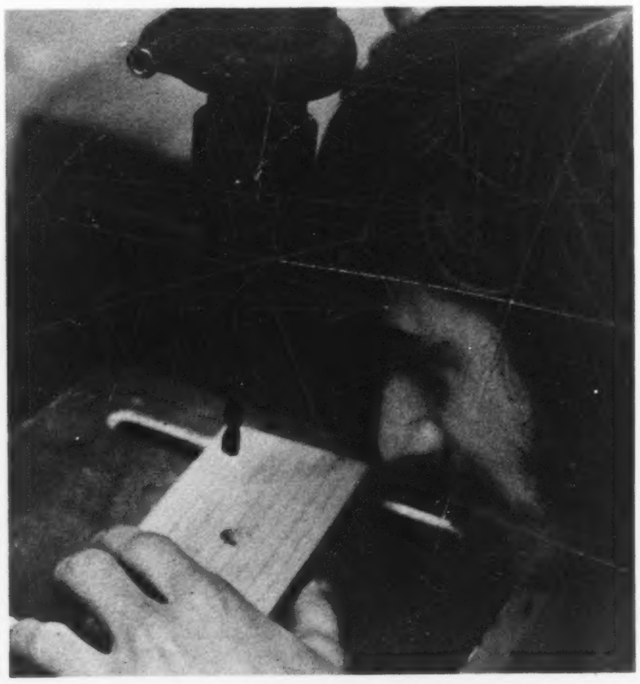


Fig. 45-7

Unsafe Condition____________________________

Safe Condition____________________________

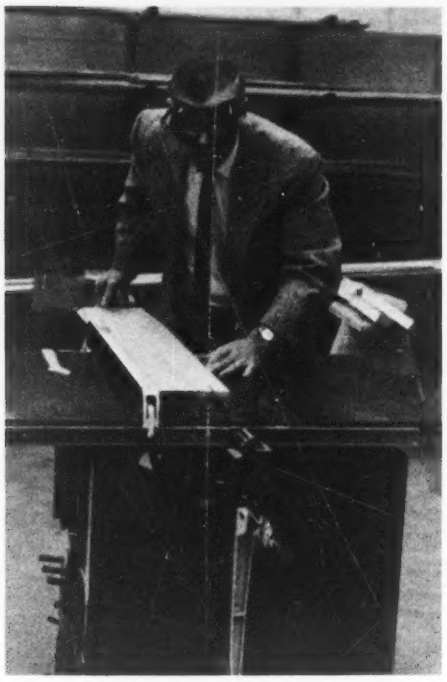


Fig. 45-8

Unsafe Condition________________________________

Safe Condition__________________________________

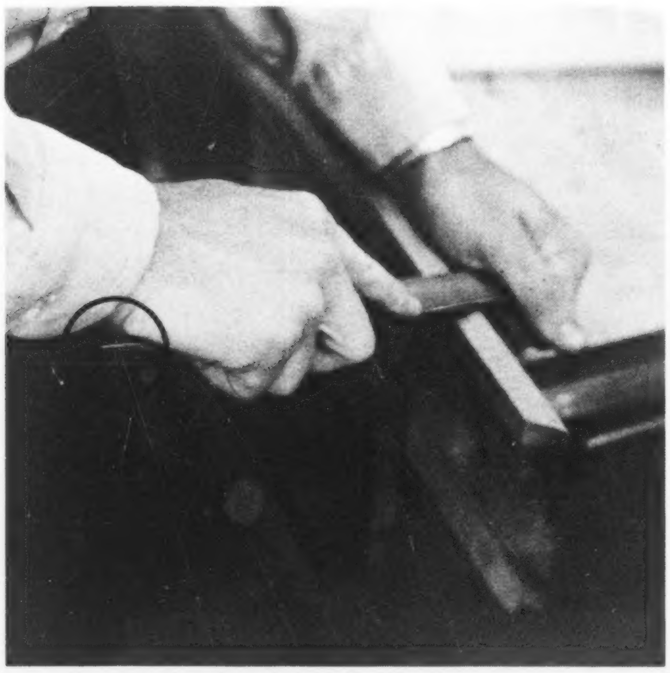


Fig. 45-9

Unsafe Condition________________________________

Safe Condition__________________________________

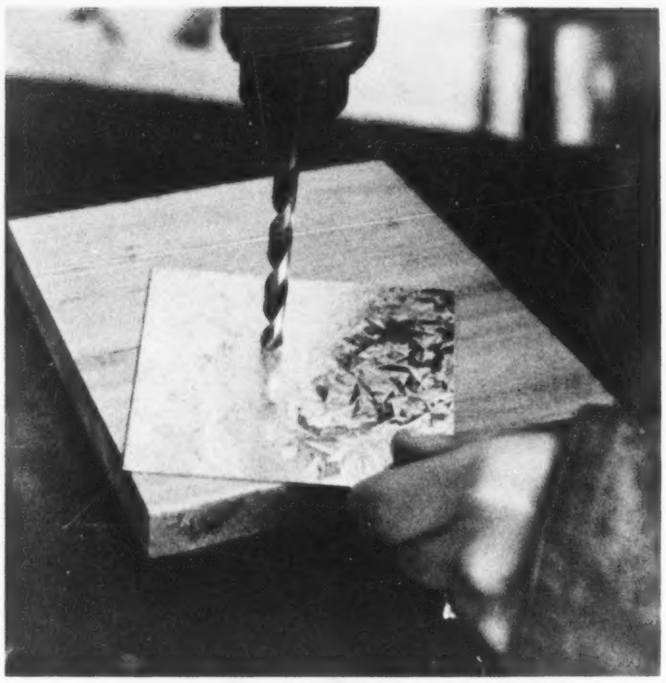


Fig. 45-10

Unsafe Condition________________________________

Safe Condition__________________________________

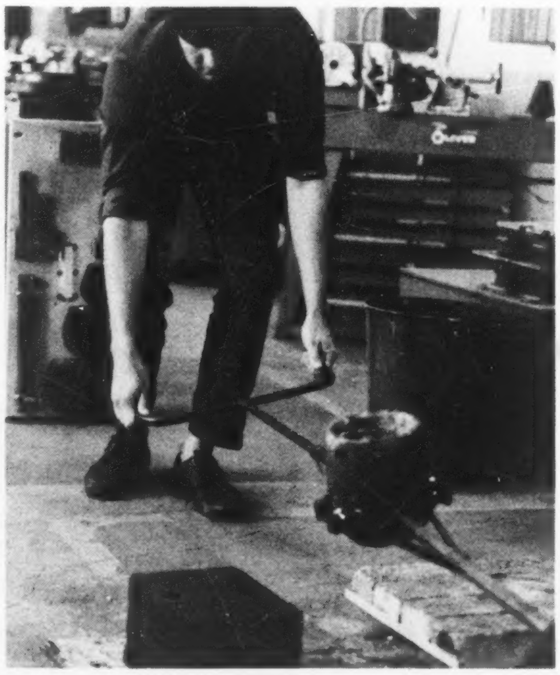


Fig. 45-11

Unsafe Condition________________________________

Safe Condition__________________________________

ACTIVITY 46A, B

Harnessing Energy from Nature

You have been learning about six general classes of energy, and about ways to harness them. Today you are to build a small steam engine. When you operate this engine later in this activity, you will be demonstrating the conversion of chemical energy (by burning a fuel) first into heat energy, and then to mechanical energy (engine's motion).

Problem

Objective

Using the equipment and instructions, build a simple engine.

Equipment (Group of 5)

1	scratch awl
1	#40 twist drill
1	hand drill
1 pr.	diagonal cutting pliers
1	backsaw with fine blade
1	V-block
4 pr.	safety glasses
1	rule

Supplies (Group of 5)

1	coat hanger
1	pipe cleaner
1 kit	epoxy glue (2 tubes)
1	size 12 snap swivel (fishing tackle)
1 pc.	3/32″ O.D. aluminum or brass tubing, 2½″ long (model-plane gas line)
1	35 mm. slide film can with lid
¼ sht.	fine emery cloth
	water
2 pcs.	¾″ thick scrap wood, about 1″ x 2″
2 pcs.	⅜″ dia. x 2″ dowel

Preparing to Work

1. Assemble with your group and get the equipment and supplies.

Cutting Tube Lengths

2. Lay out a 1¼″ length on the tubing. Hold the work *lightly* in a vise and cut with a backsaw. This should give you two pieces, each 1¼″ long.

Marking

3. Two points are to be located on the can, as follows. Set the can right side up. See Fig. 46A-1C. Place a piece of scrap wood ¾″ thick against the can, as a guide. Pencil a line 1/16″ above the top edge of the wood, all the way around the can.
4. Mark one point on the line. Mark a second point, directly opposite the first point, on the other side of the can. See Fig. 46A-1C, front view, and the stem locations opposite each other in Fig. 46A-1A.
5. Dent both spots *lightly* with a scratch awl. Use hand pressure only. *Do not use a hammer.*

Drilling

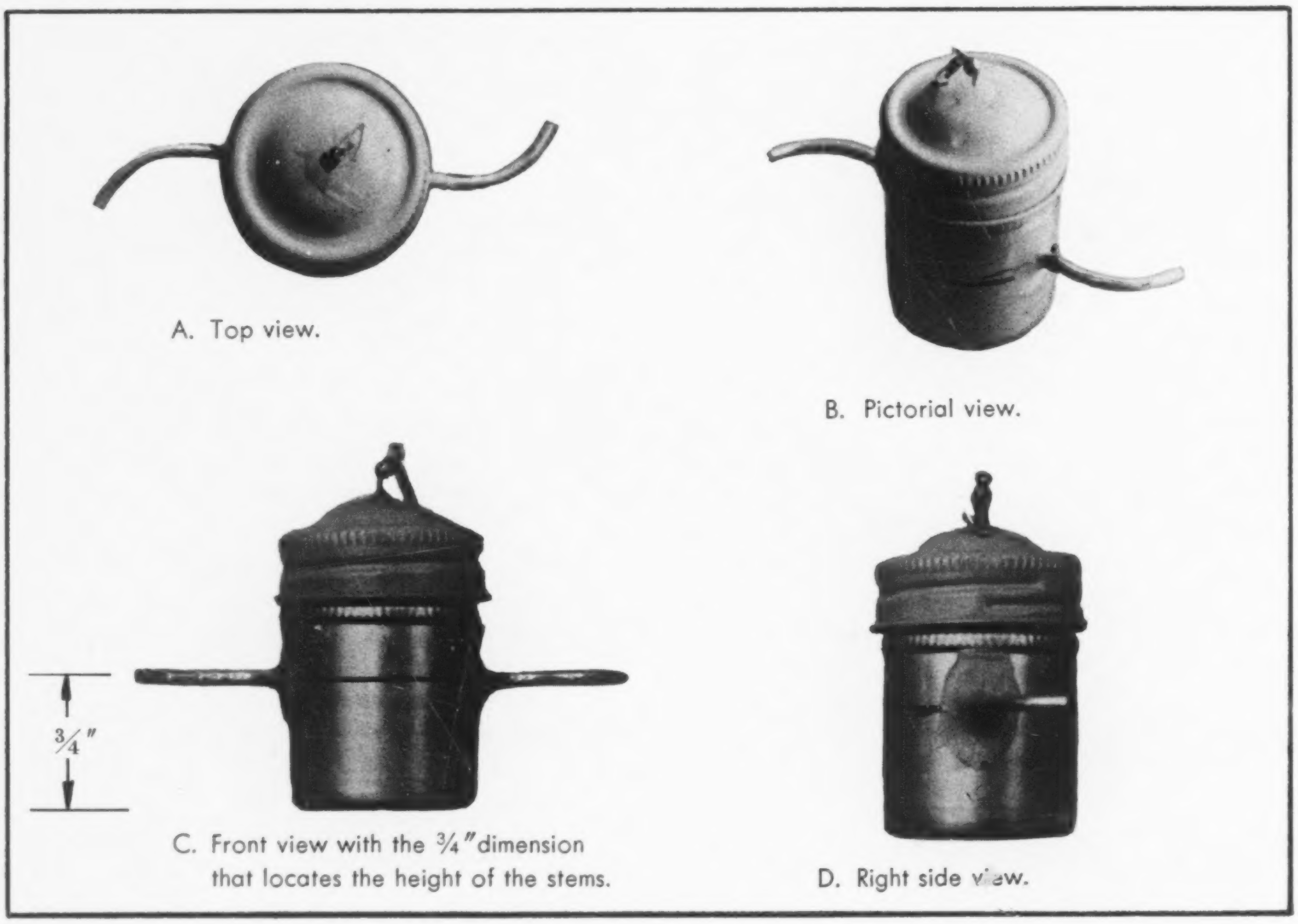
6. Screw the cap onto the can and place it in a V-block.
7. Drill holes carefully at the two marked points for the stem.

Bending the Tube

8. Cut the pipe cleaner in two pieces. Insert one piece into each tubing piece, to keep it from kinking.
9. Insert two ⅜″ pieces of dowel in the vise about 3/16″ apart. See Fig. 46A-2. With the pipe cleaners in the tubing, carefully bend the tubing.
10. Put one piece of tubing between the pieces of dowel, and bend the tubing. Leave the pipe cleaner in the tubing.
11. Repeat Step 10 for the other piece of tubing.

Assembling Lid and Swivel

12. Remove the lid from the can. Dent the



A. Top view.

B. Pictorial view.

C. Front view with the 3/4" dimension that locates the height of the stems.

D. Right side view.

Fig. 46A-1. Hero's Engine
The four major views above show the model steam engine.

center of the lid slightly; then drill a hole through the center.

13. Insert the snap swivel through the drilled hole, to the ball, and *cement it in place.* See Fig. 46A-3. Be careful not to get any cement on top of the swivel.
14. Set the lid assembly aside until the cement hardens.

Assembling Tubing and Can

15. Place a piece of 3/4" scrap wood on each side of the can, and insert the tips of the tubes 1/16". Be sure both tubes bend in the same rotary direction. See Fig. 46A-1A, top view.

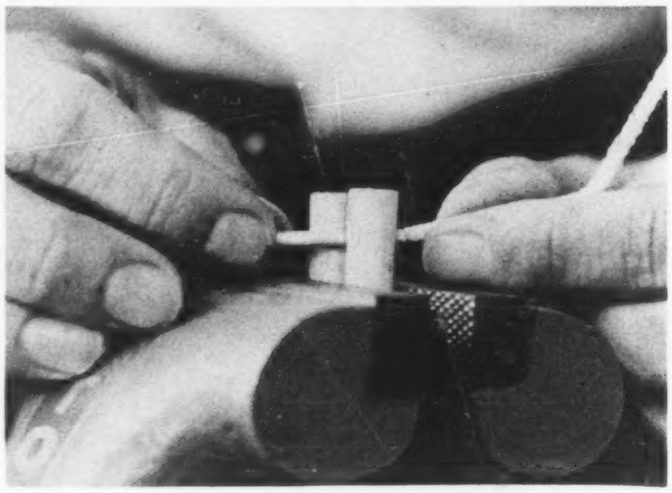


Fig. 46A-2. Bending Jig for Tubing

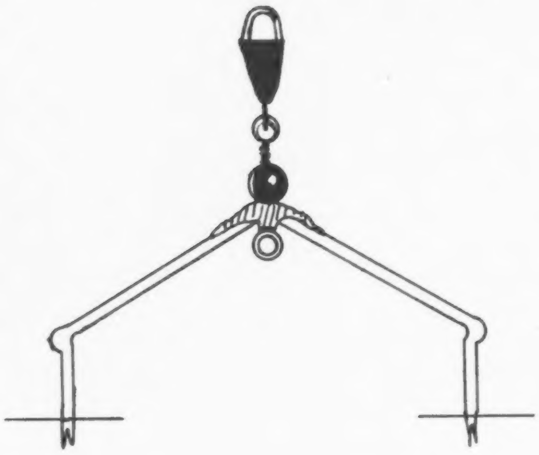


Fig. 46A-3. Snap Swivel Assembly

16. Apply epoxy to the tubes. Let the assembly sit undisturbed until the cement hardens.

Cleaning Up

17. Clean up the work area and return equipment.

Setting Up

18. Set up the coat-hanger wire in the bench vise to support your engine. See Fig. 46A-4.
19. Place about $\frac{3}{16}$" of water in the can and turn the top on tight. Notice the rubber gasket inside the top; it prevents the steam from escaping.
20. Blow through the tips to clear them of dirt before lighting the torch. If they are clogged, the can may EXPLODE!
21. *You must wear your safety glasses.* When the engine is operating, hot water sometimes sprays out the tips of the engine tubes along with the steam.
22. Hang the engine on the supporting wire.

Safety Precautions

a. Wear safety glasses to protect your eyes from boiling water.
b. Do not heat engine without water in it.
c. Take care when lighting and extinguishing the torch.

Operating

23. To light the torch, open the valve slightly and light with a match or spark lighter. *Follow safety precautions.*
24. Apply heat to the can until the engine moves steadily. Operate the engine for one minute, using a low flame. Heat is carefully applied with a propane torch until the device spins. To speed up the rotation, get the flame close. To slow it down, keep the flame back. Do not apply heat after all the water has evaporated.
25. Shut off the torch.

Cleaning Up

26. Return all equipment and supplies to their proper location in the room and clean the work area.

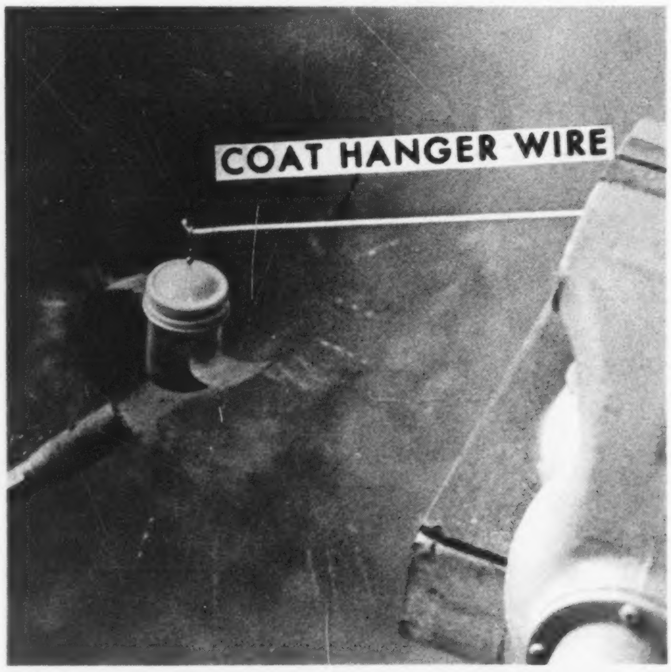


Fig. 46A-4. Showing the Steam Engine in Operation

ACTIVITY 47

Securing Reproducible Raw Materials

Problem

Objective

Given a set of 11 illustrations, identify for each one (see Figs. 47-1 to 47-11):

a. The practice shown.
b. The raw material secured.
c. The tools and equipment used.
d. A product in which the material is used.

Identifying Raw Materials

1. Below each picture, in the space provided, write a few words to describe what you see.
2. Your teacher will review each picture with you at the end of the period.

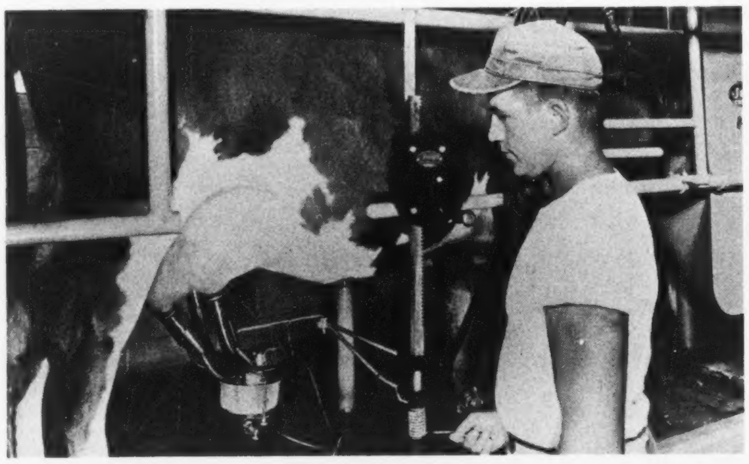


Fig. 47-2

Practice: ____________________

Raw Material: ____________________

Tools or Equipment: ____________________

Product: ____________________

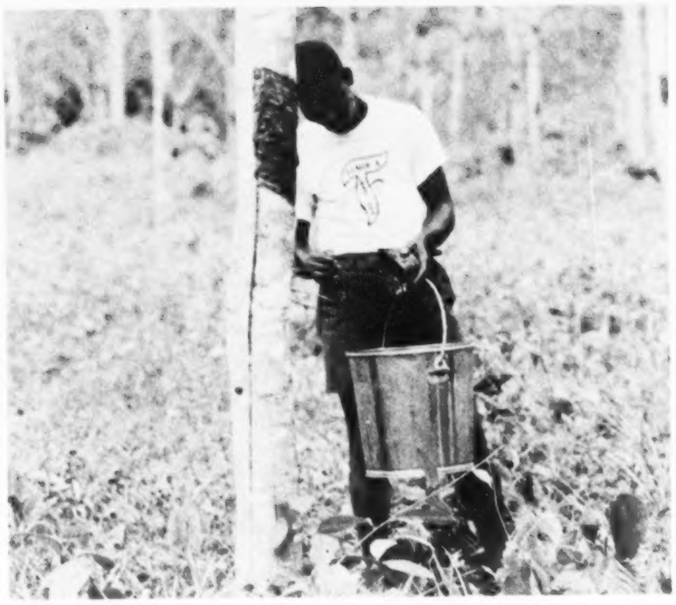


Fig. 47-1

Practice: ____________________

Raw Material: ____________________

Tools or Equipment: ____________________

Product: ____________________

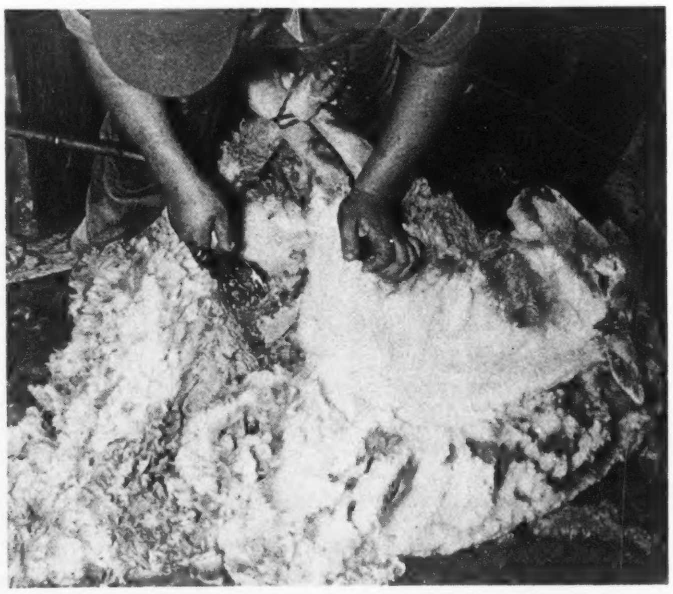


Fig. 47-3

Practice: ____________________

Raw Material: ____________________

Tools or Equipment: ____________________

Product: ____________________

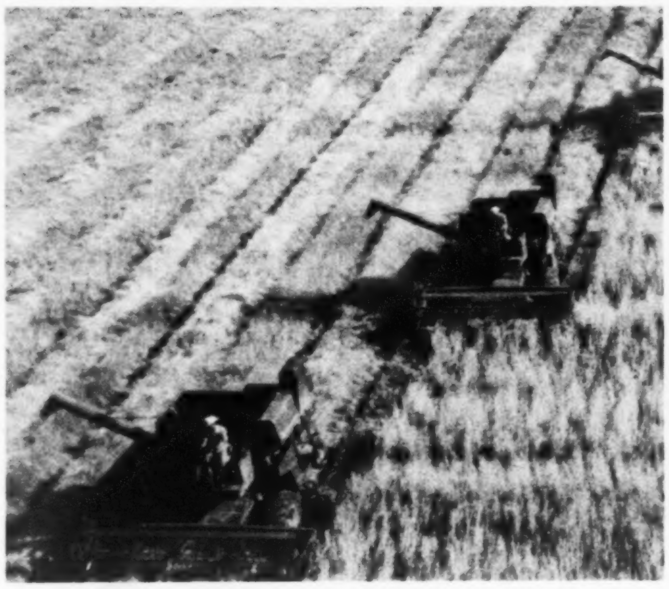


Fig. 47-4

Practice: ______

Raw Material: ______

Tools or Equipment: ______

Product: ______

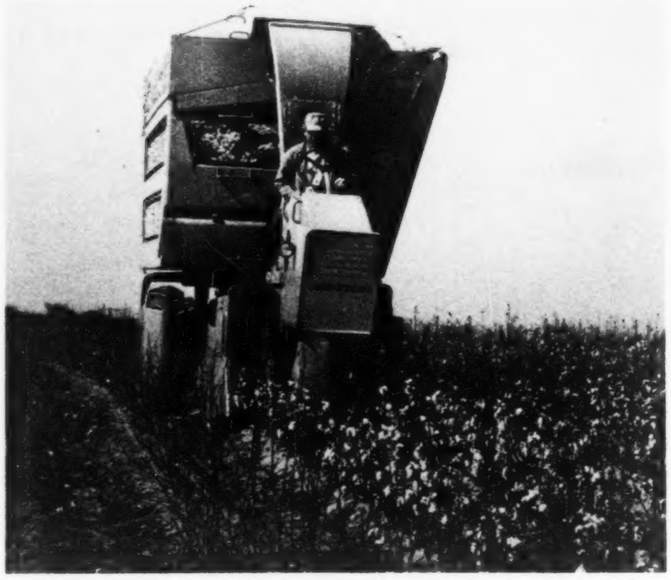


Fig. 47-6

Practice: ______

Raw Material: ______

Tools or Equipment: ______

Product: ______

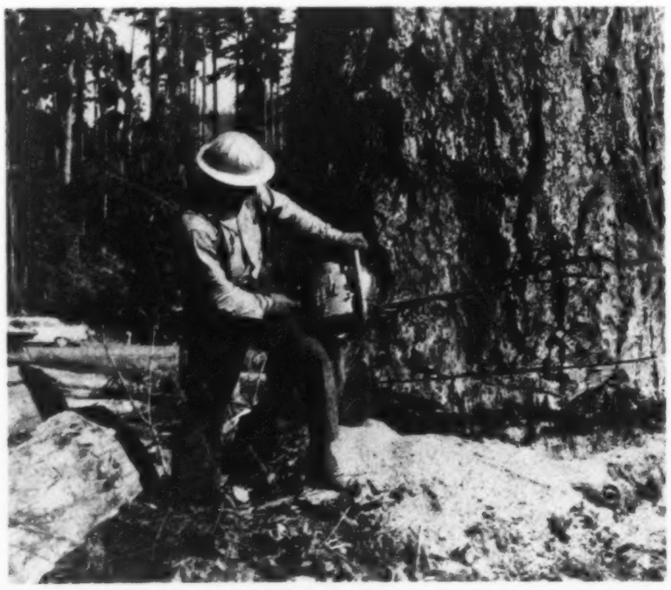


Fig. 47-5

Practice: ______

Raw Material: ______

Tools or Equipment: ______

Product: ______

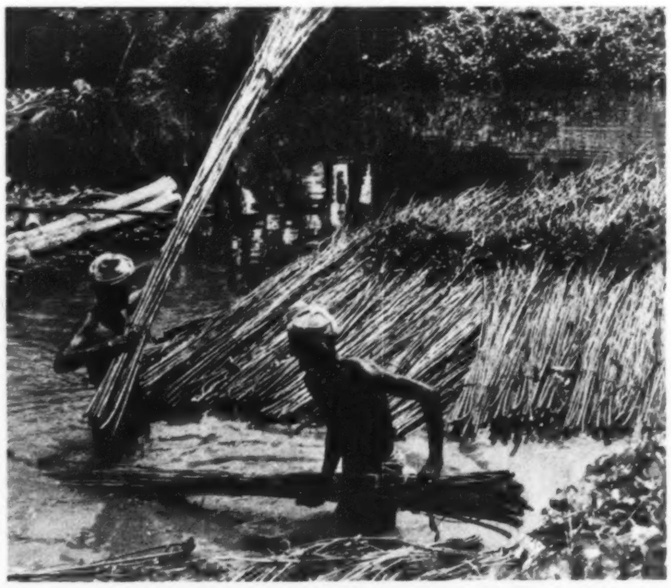


Fig. 47-7

Practice: ______

Raw Material: ______

Tools or Equipment: ______

Product: ______

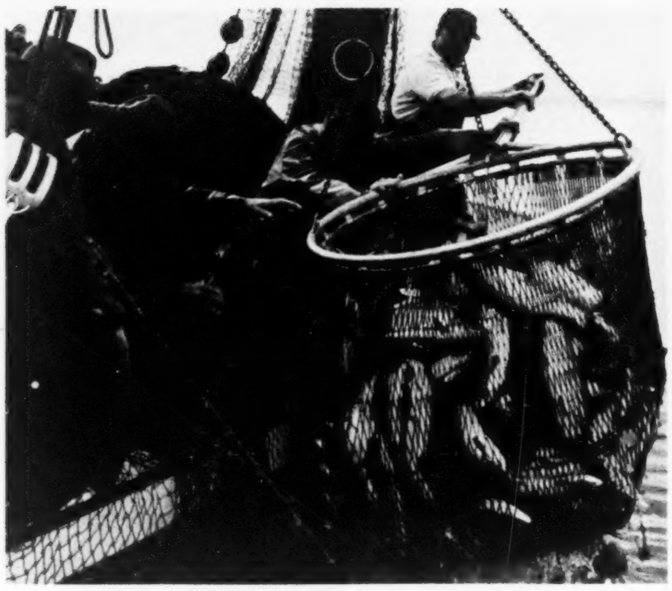


Fig. 47-8

Practice: ____________________

Raw Material: ____________________

Tools or Equipment: ____________________

Product: ____________________

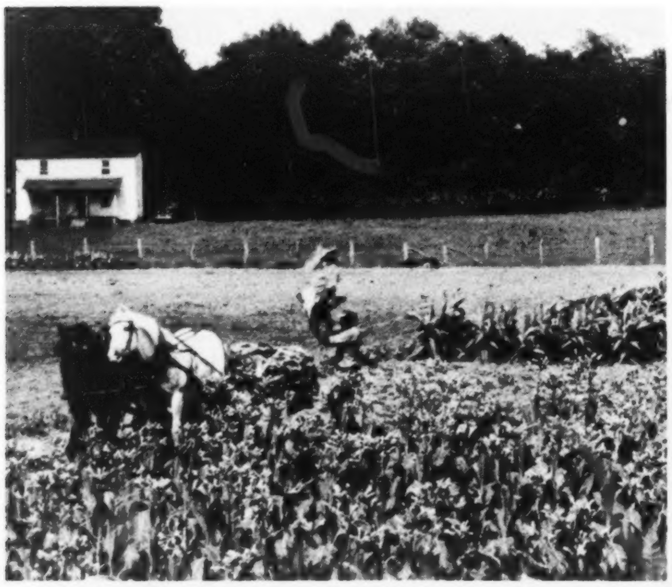


Fig. 47-9

Practice: ____________________

Raw Material: ____________________

Tools or Equipment: ____________________

Product: ____________________

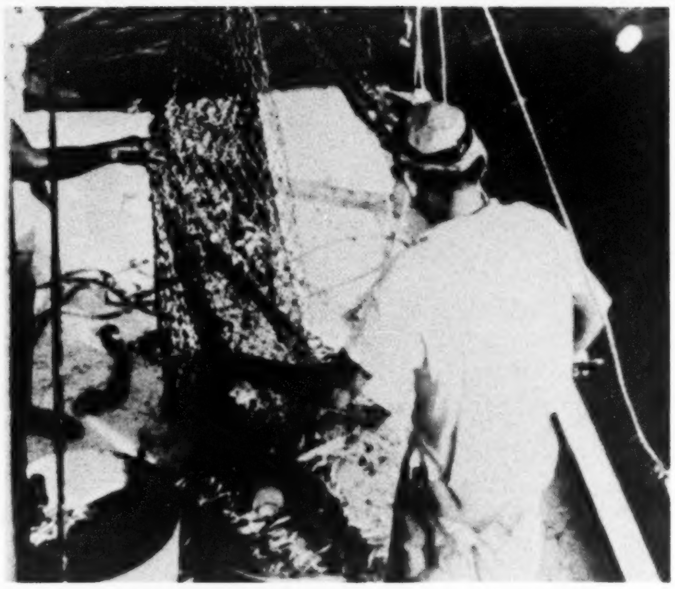


Fig. 47-10

Practice: ____________________

Raw Material: ____________________

Tools or Equipment: ____________________

Product: ____________________

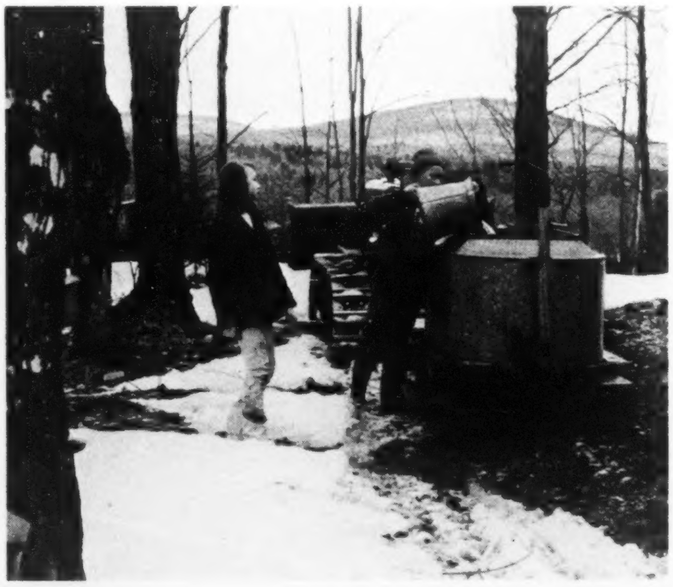


Fig. 47-11

Practice: ____________________

Raw Material: ____________________

Tools or Equipment: ____________________

Product: ____________________

ACTIVITY 48

Manufacturing Production Technology

Problem

Objective

Given pictures that illustrate the five main production stages in making a newspaper, *name the practices* that you think may be used at each stage.

Equipment (Class)

1 overhead projector/screen

Supplies (Class)

1 set Transparencies 86-1 through 5

Identifying Practices of Production

1. The class will be divided into five teams for competition in identifying production practices.
2. Choose a team name.
3. Your team will compete with the other teams to name practices that occur at each stage of newspaper manufacture.
4. When a transparency is put on the screen, the team captain has four minutes to raise his hand. The team members should work together to identify at least two preprocessing practices and two processing practices.
5. Record your team's answers in Fig. 48-1.

Scoring

6. Each team will have a chance to give its answers.
7. Each correct answer is worth five points.

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Fig. 48-1. Preprocessing and Processing at Five Stages of Newspaper Manufacture

Stage 1. Preparing Raw Materials

From a log in a forest — to wood chips in a lumber mill

a. What preprocessing occurred?

____________________ ____________________

b. What processing occurred?

____________________ ____________________

Stage 2. Making Industrial Materials

From wood chips in a lumber mill — to pulp sheets at a pulp mill

a. What preprocessing occurred?

____________________ ____________________

b. What processing occurred?

____________________ ____________________

Stage 3. Making Components

From pulp sheets at a pulp mill — to a roll of paper leaving a paper mill

a. What preprocessing occurred?

____________________ ____________________

b. What processing occurred?

____________________ ____________________

Stage 4. Combining Components

From a roll of paper at the paper mill — to one complete newspaper in the press room

a. What preprocessing occurred?

____________________ ____________________

b. What processing occurred?

____________________ ____________________

Stage 5. Preparing for Distribution

From one complete newspaper in the press room — to many bundles of newspapers on the newspaper's loading dock

What activities occurred? (Name four.)

____________________ ____________________

____________________ ____________________

ACTIVITY 49

Converting Raw Materials to Industrial Materials

Today you will experiment with one of four techniques commonly used to sort or separate materials: (1) screen sorting, (2) magnetic sorting, (3) distilling, and (4) two techniques of filtering.

The class will be divided into five groups. Group 1 students will work on *Problem 1;* Group 2 students will work on *Problem 2;* Group 3, *Problem 3;* Group 4, *Problem 4;* and Group 5 will work on *Problem 5.*

Problem 1
Group 1

Objective

Using a mixture of sand and aggregate and the needed equipment, screen-sort the mixture by size, measure, and record the results.

Equipment

1	sieve screen set No. 87
1	16 oz. measuring cup
1	coffee can *or* similar container

Supplies

16 oz.	dry, random-mixed sand and aggregate
2 pcs.	heavy paper, approx. 24" x 24"
	rags

Preparing to Work

1. Equipment supervisor get the necessary equipment and supplies.
2. Carefully measure 16 ounces, by volume, of the mixed sand and aggregate. Put it in the coffee can.

Refining by Screening

3. Stack the screens in proper order (largest hole size on top). Place a piece of paper under them. See Fig. 49-1.
4. Place the sand and aggregate on the top screen. Be careful not to spill any of the mixture outside the screens.
5. Shake the screens from side to side for two minutes.
6. Remove Screen 3. Carefully place on a piece of paper all the coarse aggregate trapped by this screen. To remove material with the least spillage, place paper on top of screen and turn over carefully.

Measuring

7. Pour the coarse aggregate from the paper into the measuring cup, and find its volume, in ounces. Record this amount in Fig. 49-2.

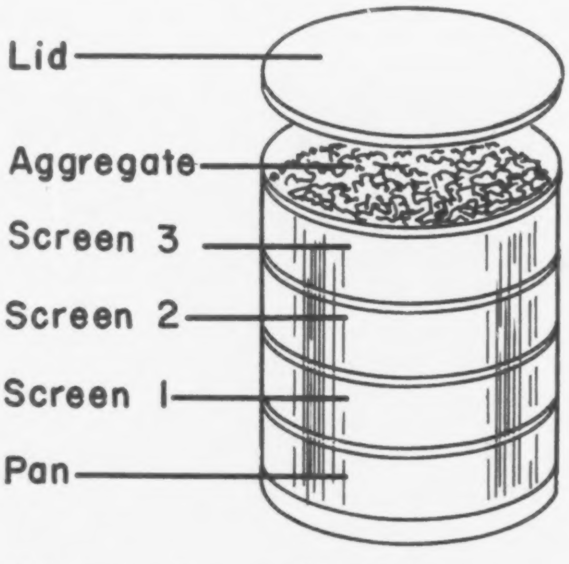


Fig. 49-1. Screen Placement for Refining

Screen Number	Amount Screened Out (held back by screen)
3 (coarse)	______ oz.
2 (medium)	______ oz.
1 (fine)	______ oz.
Residue	Amount: oz.

Fig. 49-2. Amounts of Material Screen-Sorted from Mixture

8. Store the sorted and measured aggregate in the coffee can.

Sizing

9. Repeat Steps 5-9 for each remaining screen.
10. Measure and record the amount of residue that sifts through the first screen.
11. Put the residue back in the coffee can and shake the material to mix it.
12. Clean the work area and then answer the following questions.
13. Select a person to explain the technique and provide the answers to other groups of students.

Questions

1. How much raw material did you have before you started refining?

_____ oz.

2. Add the three amounts you recorded in Fig. 49-2. (a) Is this the same as your answer in Question 1?

_______________ (b) Explain ___________

____

____

3. If you had measured the mixture and the sorted amounts by weight (instead of volume), would your answer to Question 2 be "yes" or "no"?

____

4. Which screen or pan collected the most raw materials?

Screen _____

5. If you were interested only in the raw material retained in Screen 2 for your product, how much waste materials was separated out by screening?

_______ oz.

6. What would you do with the waste material if you were the refiner?

____

Problem 2
Group 2

Objective

Using a mixture of iron filings, sand, and the needed equipment, separate the iron from the sand magnetically.

Equipment

1	magnet
1	stirring rod (small stick)
1	8 oz. measuring cup

Supplies

1 oz.	iron filings (measured by volume)
8 oz.	sand (measured by volume)
1 pc.	heavy paper, approx. 24″ x 24″
1	plastic bag, sandwich size

Preparing to Work

1. Equipment supervisor get the necessary equipment and supplies.
2. Place sand and iron filings on the paper.
3. Mix sand and iron filings together, and spread out the mixture evenly.

Refining by Magnetic Sorting

4. Place the magnet in a plastic bag.
5. Pull the magnet through the sand until a maximum load is picked up.
6. Hold the magnet and bag over the measuring cup.
7. Remove the magnet from the bag, allowing iron filings to fall into the cup.
8. Repeat Steps 4-7 until you have retrieved all the iron filings.
9. Follow your teacher's instructions about what to do with the separated materials. Return equipment and clean the work area.
10. Select a person to explain the technique and provide the answers to the other groups of students.

Questions

1. Magnetic sorting has a limited number of uses. For example, it would not separate sugar from sand. Why?

2. If you were a vendor of iron and obtained it by magnetic sorting from sand, (a) What would be your refined material?

   (b) What would be your waste material?

3. If you were a vendor of clean sand, (a) What would be your refined material?

   (b) What would be your waste material?

Problem 3
Group 3

Objective

Using the necessary equipment and supplies, purify water by distilling it.

Equipment

1	1000 ml. capacity, flat-bottom boiling flask
1	rubber stopper for flask with ¼″ tube hole
1 pc.	¼″ O.D. glass tubing approx. 3″ long (to fit stopper hole)
1 pc.	¼″ I.D. flexible tubing approx. 30″ long
1	tripod ring stand with screen
1	propane torch *or* other heat source
1	16 oz. beaker *or* equivalent
1 pr.	asbestos gloves

Supplies

2 oz.	soil or clay
1 pc.	cardboard approx. 4″ x 4″ with ¼″ hole
	water

Safety

1. Be sure tubing is not stopped up. Steam pressure will build up if the steam cannot flow through the tubing freely.
2. Water should boil steadily, but not too hard.
3. NEVER let a flask boil dry.

Preparing to Work

1. Equipment supervisor get the necessary equipment and supplies.
2. Fill the flask half full of water.
3. Add a small amount of soil and shake into a muddy mixture.
4. Assemble the stopper, glass tubing, and flexible tubing as in Fig. 49-3, or check the coupling if the pieces are already assembled.
5. *Test the tubing assembly and be sure it is not clogged.* Try blowing into one end of the tube, and holding one hand below the other end. Can you feel the air coming out of the tube?
6. Cork the flask with the stopper and set up the problem as shown in Fig. 49-4.

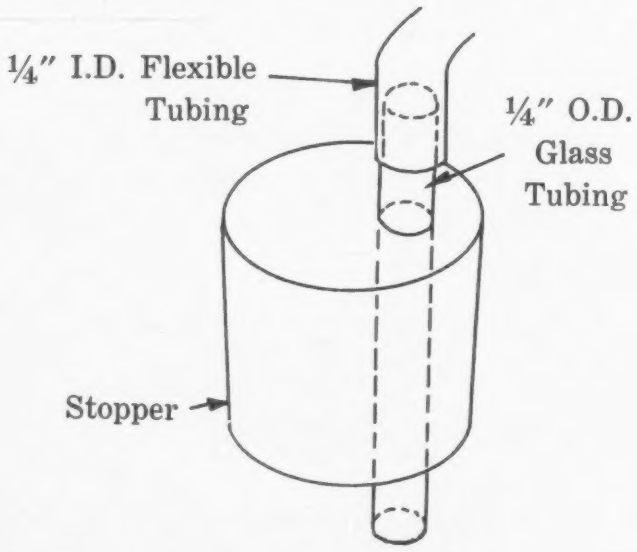


Fig. 49-3. Stopper and Tubing Assembled

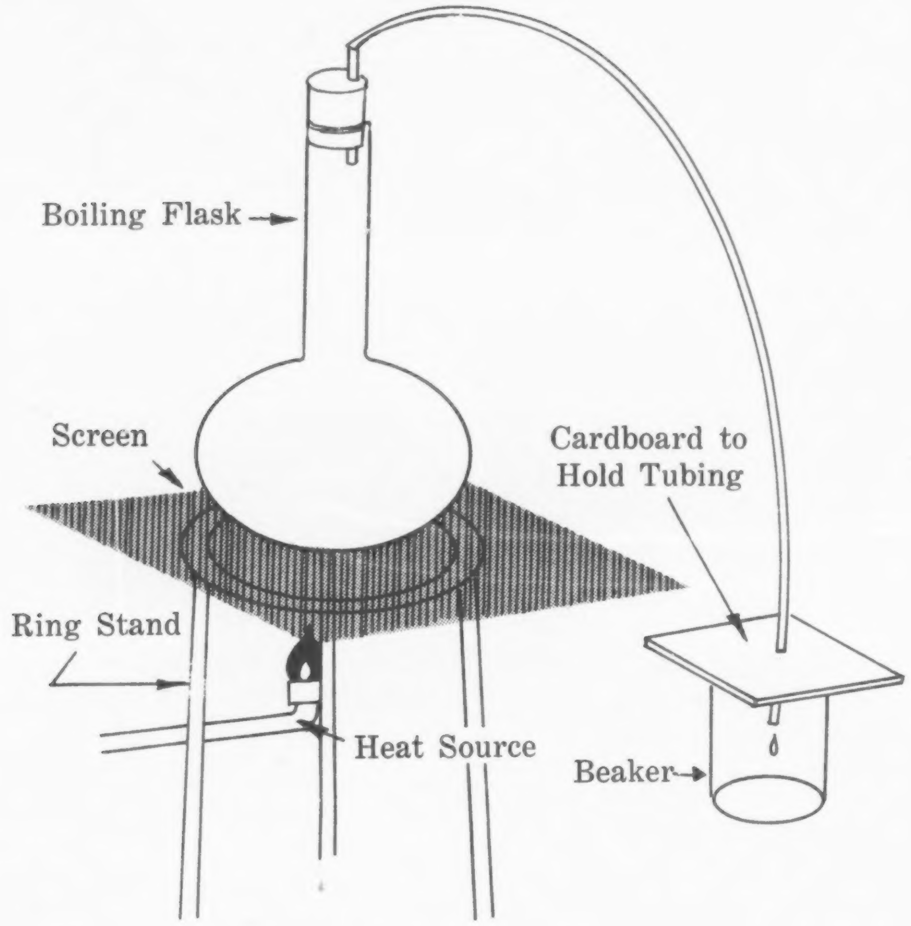

Boiling Flask
Screen
Cardboard to Hold Tubing
Ring Stand
Heat Source
Beaker

Fig. 49-4. Experimental Setup

Distilling

7. Light the propane torch and heat the flask as shown in Fig. 49-4.
8. After the water has boiled a few minutes turn off the torch.
9. Select a person to explain the technique and provide answers to the other groups of students.

Questions

1. What happened when the water began to boil?

____

____

____

2. Is the distilled water clear or muddy?

____

3. What happened to the mud?

____

____

Problem 4
Group 4

Objective

Using the necessary equipment and supplies, separate a liquid from a solid by filtering.

Equipment

2	8 oz. Owens Oval bottles *or*
2	common narrow-necked 8 oz. bottles *and*
1	8 oz. measuring cup
1	2 oz. funnel

Supplies

1 pc.	filter paper
1 tsp.	chalk dust
	water

Preparing to Work

1. Equipment supervisor get the necessary equipment and supplies.
2. Place the chalk dust in the bottle and pour in about two ounces of water.
3. Fold the filter paper twice, and fit it into the funnel. See Fig. 49-5.
4. Place the funnel in an empty bottle. See Fig. 49-6.
5. Shake the dust and water mixture, and pour it into the funnel.
6. Continue pouring until all the water has passed through the filter paper.

Recording

7. Measure and record the volume of filtered water:

   _______ oz.
8. Discard the used filter paper.
9. Clean all equipment.
10. Select a person to explain the technique and provide answers to the other groups of students.

Questions

1. What material did you purify or refine?

   ____
2. What waste material was trapped by the filter paper?

   ____
3. If the waste material had been salt, could you have purified the water by filtering?

   ____

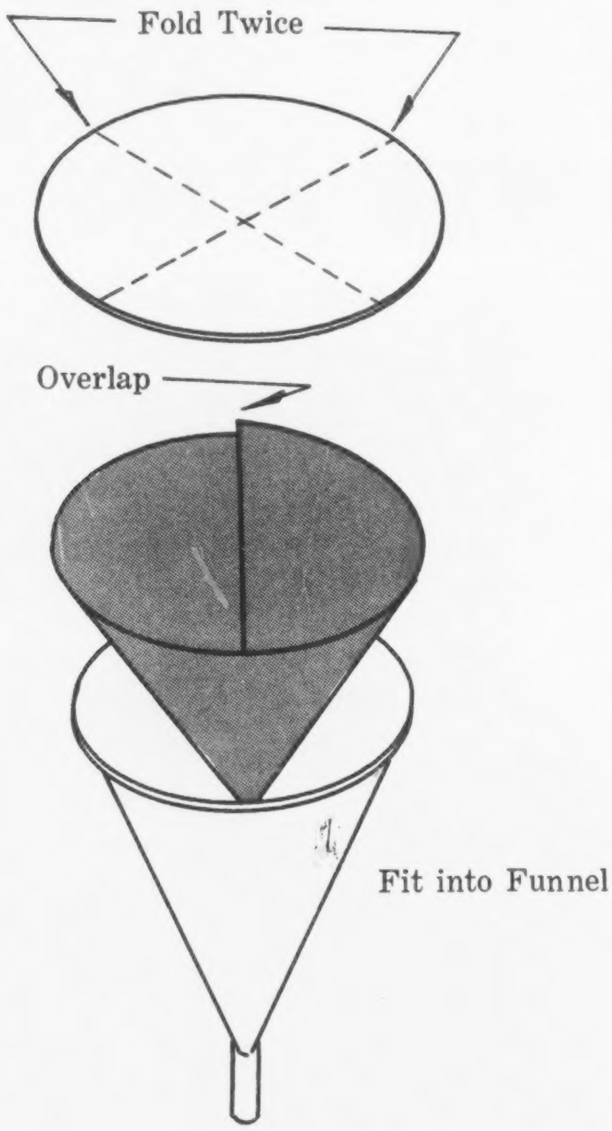


Fig. 49-5. Fitting Filter Paper to Funnel

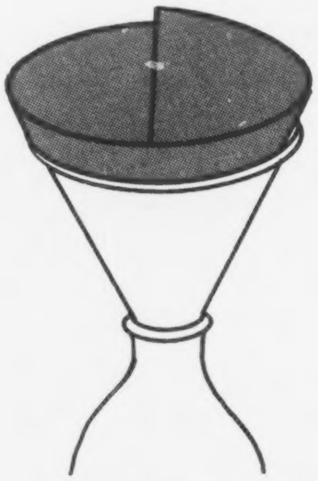


Fig. 49-6. Funnel Supported in Bottle

4. How is salt removed commercially from sea water?

Problem 5
Group 5

Objective

Using the necessary equipment and supplies, separate water from oil by filtering.

Equipment

2	8 oz. Owens Oval bottles *or*
2	common narrow-necked 8 oz. bottles *and*
1	8 oz. measuring cup
1	2 oz. funnel
1	coffee can *or* similar container

Supplies

4 oz.	oil and water mixture *or*
3 oz.	water *and*
1 oz.	oil
1 pc.	filter paper

Preparing to Work

1. Equipment supervisor get the necessary equipment and supplies.
2. Fold the filter paper twice, and fit it into the funnel. See Fig. 49-5.
3. Place the funnel in an empty bottle. See Fig. 49-6.

Refining by Filtering

4. Shake the oil and water mixture, and pour a little into the funnel. Allow the funnel to empty before adding more.
5. Continue until the oil has been filtered out of the water.

Recording

6. Measure and record the volume of liquid that passed through the filter paper:

_______ oz.

7. Pour the oil into a coffee can. Discard the filter paper and water.

Bulking

8. Prepare the oil and water mixture for the next class. Be sure you combine three ounces of water and one ounce of oil.
9. Clean all equipment.
10. Select a person of your group to explain the technique and provide the answers to the other groups of students.

Questions

1. What technique of refining did you use?

____

2. What volume of raw material did you have at the start?

_______ oz.

3. What volume of clear water did you refine?

_______ oz.

4. How much oil was caught as waste material?

_______ oz.

ACTIVITY 50

Making Industrial Materials into Standard Stock

Today you will simulate the making of standard stock (paper) from an industrial material (pulp).

Problem

Objective

Using the equipment and supplies, manufacture a sheet of paper by performing mixing, screening, sizing, and drying operations.

Equipment (Group of 5)

1	plastic tote tray
1	egg beater
1	stirring stick
1	12″ rule
1	flat electric iron
1	screen (Screen #1 from ACTIVITY 49)
1	6″ hand roller
1	tablespoon

Supplies (Group of 5)

2 tbsp.	liquid starch
20 pcs.	12″ x 12″ blotting paper or paper towels
½ box	nonwet strength tissues (180 sheets per box)
10 pcs.	8½″ x 11″ paper
1	plastic sheet
1 btl.	food coloring
1 qt.	sizing mixture, in shallow pan

Preparing to Work

1. Assemble with your group at your work station.
2. Obtain the equipment and supplies for your group. Cover the bench top with the plastic sheet.

Mixing Pulp Mixture

3. Tear tissue paper into little pieces and put it into the plastic tote tray.
4. Fill the tray with hot water to about 1½″ below the top.
5. Stir the mixture thoroughly with a stick until the fibrous material breaks down into pulp.
6. Add two tablespoons of liquid starch (bonding material) and beat the mixture with an egg beater for several minutes.

Screening

7. Place the screen, at an angle, into the pulp mixture. See Fig. 50-1.

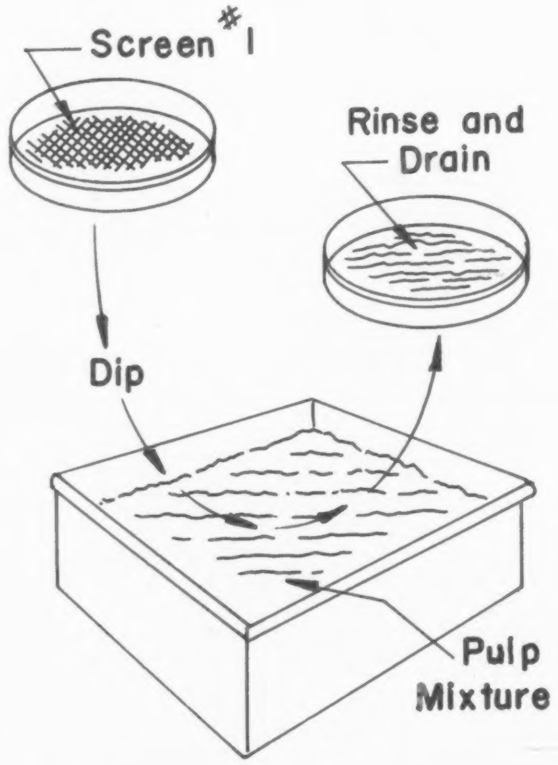


Fig. 50-1. Screening Pulp Mixture

8. Raise the screen slowly above the water, allowing the excess water to drip into the tray.

Removing Paper for Drying

9. Place the screen, with the pulp mixture, face down on paper towels.
10. Slowly lift the screen, beginning at one corner. The sheet of paper will cling to the blotting paper and pull away from the mold.
11. Rinse the screen under running water to remove excess pulp.
12. Repeat Steps 9 to 11 until every member in your group has performed this operation.

Drying

13. Place a second sheet of blotting paper over the wet sheet of paper.
14. Put pressure on the paper for several minutes to remove excess water. This can be done by either rolling the paper or putting a heavy weight on paper.
15. Remove the sheet of paper from the wet paper towel, and place it between two dry sheets of paper towels.
16. Run a warm iron over the paper towels.

Sizing the Paper

17. Place your sheet of paper into the sizing mixture until it is covered, and then remove it.

Drying

18. Lay the sheet of paper on a dry piece of paper towel.
19. Place a piece of plain 8½" x 11" paper on top.
20. Press out the excess sizing material with a hand roller.
21. Put your sheet of paper on a dry paper towel.
22. Place a clean sheet of 8½" x 11" paper on top of your sheet of paper.
23. Using a flat iron, press dry.
24. Trim the sheet of paper, removing all ragged edges. You now have a "standard stock" sheet of handmade paper.
25. Write your name on the paper, using a pen.
26. Return all equipment and clean the work area.

ACTIVITY 51A

Story of Primary Metal Products

Problem

Objective

Using a simulated raw material (lead):

a. Melt the lead.
b. Remove impurities.
c. Cast the molten lead into a cavity.
d. Roll the cooled lead into sheet stock.

Equipment (Each student)

1 pr.	safety glasses *or* face shield

Equipment (Group of 5)

1	tripod ring stand
1	propane torch with utility burner and flame spreader
1	skimmer
3	bricks
1	slip roll
5	¼" x 1" x 12" strike bars
5 pcs.	12" x 12" Transite *or* equivalent
1 pc.	12" x 24" Transite *or* equivalent
1	5" melting ladle
1 pr.	slip-joint pliers
1	hammer
1 pr.	asbestos gloves
1	bench rammer
1	foundry screen (fine)
1	12" rule
1	1 gal. bucket, for sand

Supplies (Group of 5)

5 lb.	pig lead
25 lb.	molding sand
1 lb.	nonsilica parting compound
5	mold patterns (24-pica slugs)
10 pcs.	½" x 2" x 6" common lumber
10 pcs.	½" x 2" x 5" common lumber
40	#6 common nails
10	8" x 8" molding boards (½" plywood)

Safety

1. Wear asbestos gloves and safety glasses when pouring molten metal.
2. Pour just enough molten lead to fill the cavity.
3. There should be no moisture in the mold.
4. Heat skimmer before skimming slag.

Preparing to Work

1. Assemble with your group (five students) at your work station. Each student will make a mold and pour a lead bar.
2. The group foreman will assign tasks as follows:
   a. Two students to set up tripod ring stand and propane torch.
   b. One student to prepare melting ladle.
   c. Two students to obtain sand.
3. Put on your safety glasses and check safety regulations.
4. Set up the ladle in the tripod ring stand and prepare the torch on a 12" x 24" piece of Transite. See Fig. 51A-1.

Melting Metal

5. Place the 5-pound quantity of lead in the pouring ladle and heat until the metal

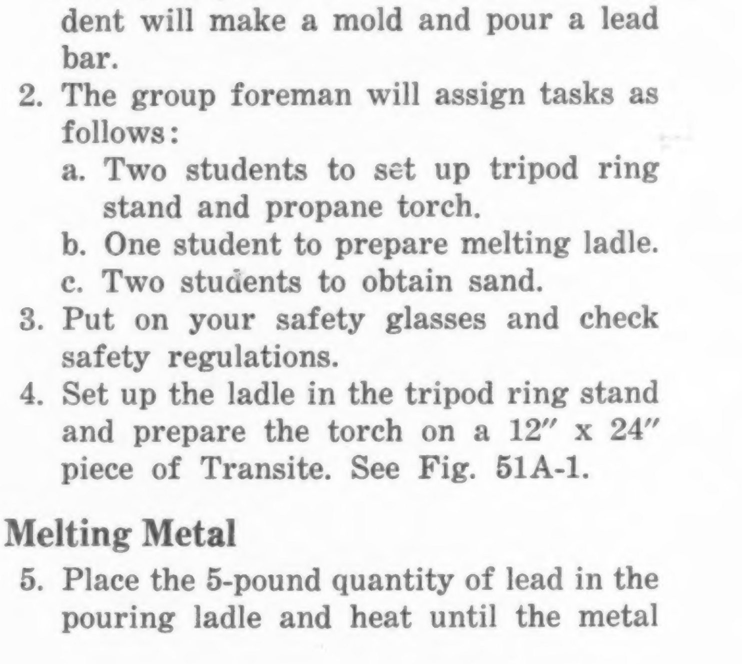


Fig. 51A-1. Ladle in Ringstand

becomes molten. Be careful not to disturb the ladle while the metal is melting. This lead must reach a temperature of 620°F. in order to melt and pour satisfactorily.

Making One-Piece Flask

6. Each student in the group is to make his own flask. Nail the four pieces of wood together. See Fig. 51A-2.

Making Mold

7. Place the one-piece flask on a bottom molding board. See Fig. 51A-3.
8. Insert the mold pattern into the flask and cover with parting compound.
9. Use foundry sand free from impurities; firmly ram the mold with a bench rammer. See Fig. 51A-4.
10. Strike off the top surface of the mold with the strike bar. Place a second molding board on top of the flask. Turn the flask over, holding both boards firmly to the flask.
11. Carefully remove the bottom molding board. Now remove the mold pattern. This leaves a cavity into which you will pour the metal. See Fig. 51A-5.
12. Place mold and molding board on a 12" x 12" piece of Transite for the casting operation (Step 14).

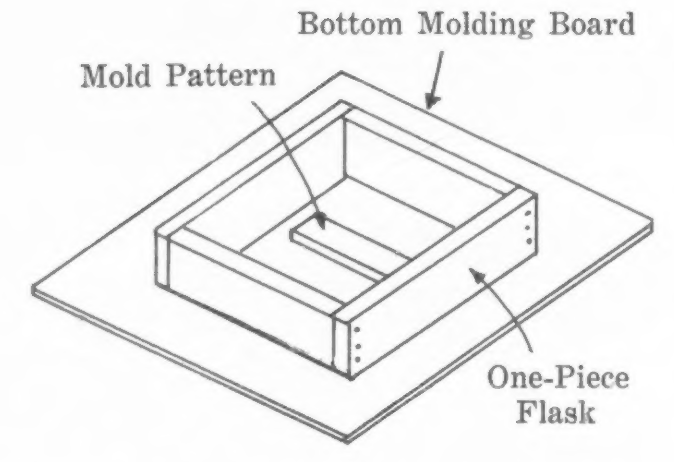


Fig. 51A-3. Flask on Board , Pattern in Place

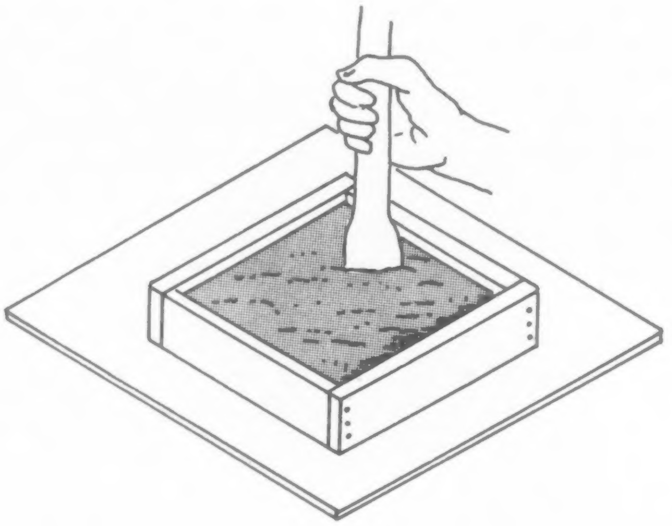


Fig. 51A-4. Ramming Mold

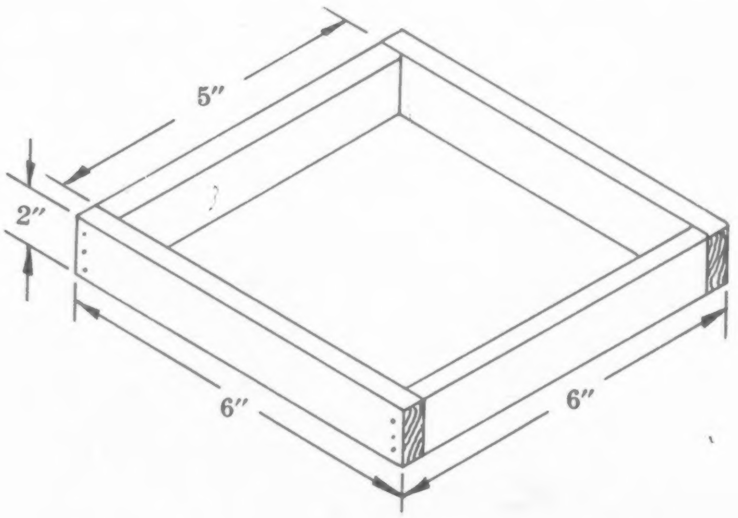


Fig. 51A-2. Flask Made from ½" Lumber (2" x 5" and 2" x 6" Boards)

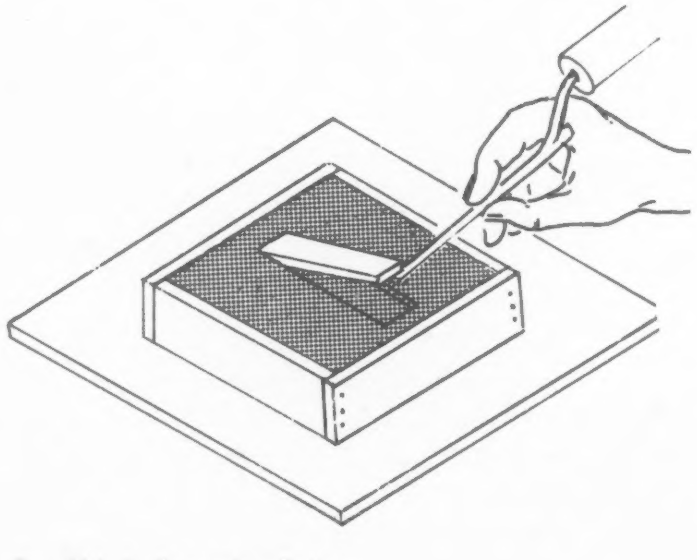


Fig. 51A-5. Removing Pattern

Refining

13. As the lead becomes molten, heat the skimmer over the open flame. If the skimmer is not heated, the molten lead will spatter. Then skim off the slag (impurities) which float to the top.

Casting

14. Cast the metal. BE CAREFUL. *Use gloves.* Pour only enough metal into the cavity to fill the mold. See Fig. 51A-6.
15. Allow the lead to cool for five minutes before removing it from the mold.

Checking

16. Have the teacher check your casting to make sure it has solidified. Remove it from the sand with a pair of pliers and cool it to room temperature under running water. See Fig. 51A-7.

Rolling

17. Roll the slab into a plate, using the slip roll. See Fig. 51A-8. Adjust the machine to accept your cast slab. Apply a ¼-turn of the pressure handle for each pass of the slab through the rolls. When the stock is rolled to a 1/16-inch thickness, stop the process. You have now rolled the cast slab into a plate. See Fig. 51A-9.

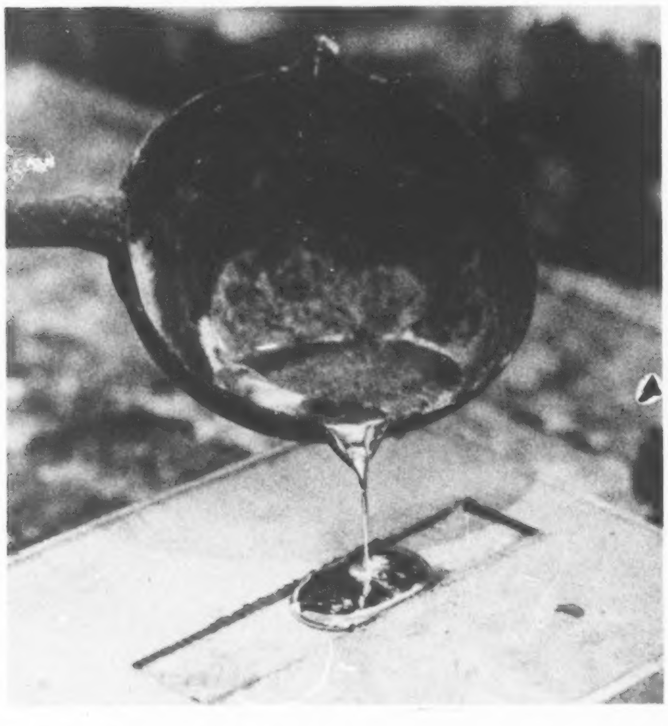


Fig. 51A-6. Pouring Metal

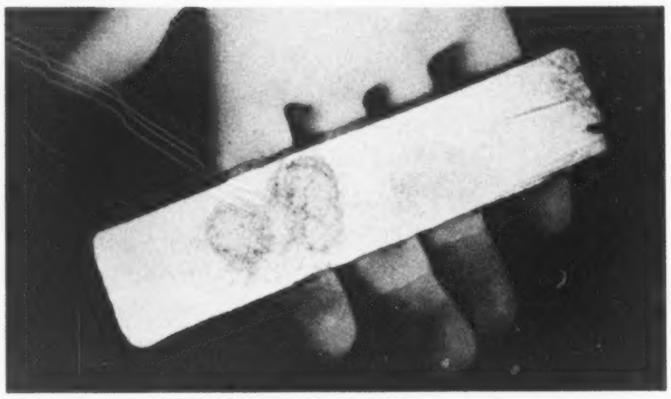


Fig. 51A-7. Completed Casting

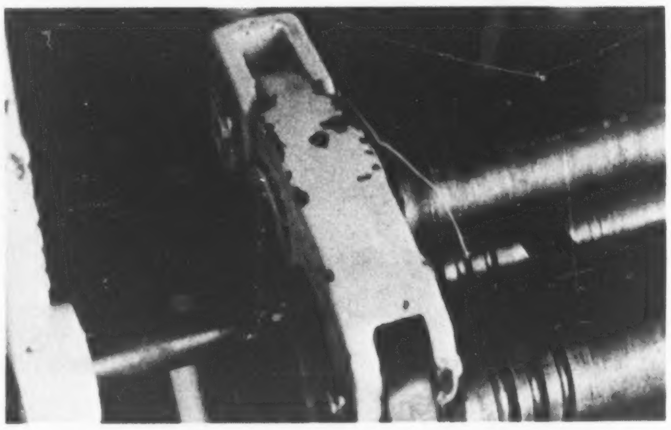


Fig. 51A-8. Using Slip Roll

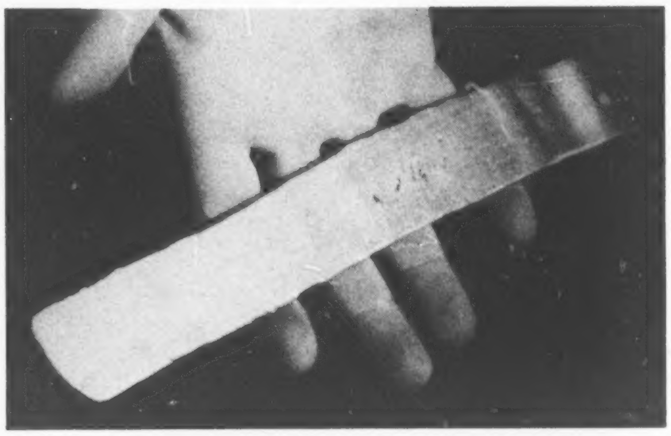


Fig. 51A-9. Rolled Plate

Cleaning Up

18. Return all equipment and supplies, and clean the work area.

Questions

1. Lead is ready to be cast into slabs when it reaches a temperature of ______ °F.
2. Refining is done by s______________ off the impurities which float to the top of the molten metal.
3. The metal is cast into s______________ to be later rolled into plates.
4. The thickness of a metal slab can be reduced by r______________.
5. The end result of refining, casting, and rolling metal is st______________ st______________.

ACTIVITY 51B

Story of Textile Mill Products

Problem

Objective

Given a natural textile fiber in raw form:

a. Refine the fiber by removing the seeds and washing the material.
b. Comb the refined fiber into yarn.

Equipment (Group of 5)

1	metal-bristled brush (A dog brush is suitable.)
4	pocket combs
10	¾″ x 2″ x 2″ blocks of wood covered with 3/0 abrasive paper (Cut blocks from scrap and cement or glue paper to surface.)
1	shallow container (A metal baking pan, 1½″ x 10″ x 10″, will serve.)
1	3″ dia. funnel

Supplies (Group of 5)

5	5″ cardboard mailing tubes *or*
5 pcs.	¾″ dowel, 5″ long
5	cotton bolls
1 pt.	cleaning solution (mineral spirits paint thinner), in stoppered, labeled container
1 pkg.	paper towels

Safety

1. Do not place hands near face when using cleaning solution.
2. Wash hands after using cleaning solution.
3. Avoid prolonged breathing of cleaning solution fumes.

Preparing to Work

1. Assemble with your group at your work station and obtain the equipment and supplies.
2. Review safety precautions with your instructor.

Refining

3. Pick all seed and chaff material from the bolls. See Figs. 51B-1 and 51B-2.

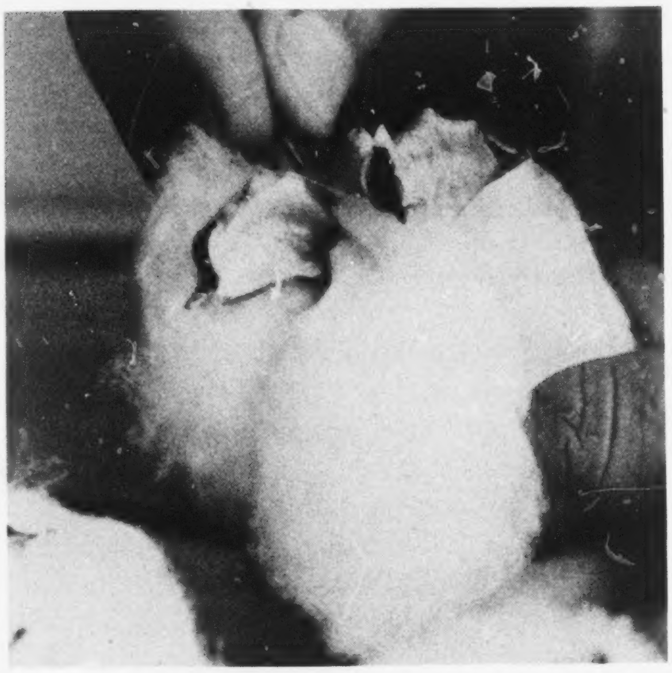


Fig. 51B-1. Removing Seed

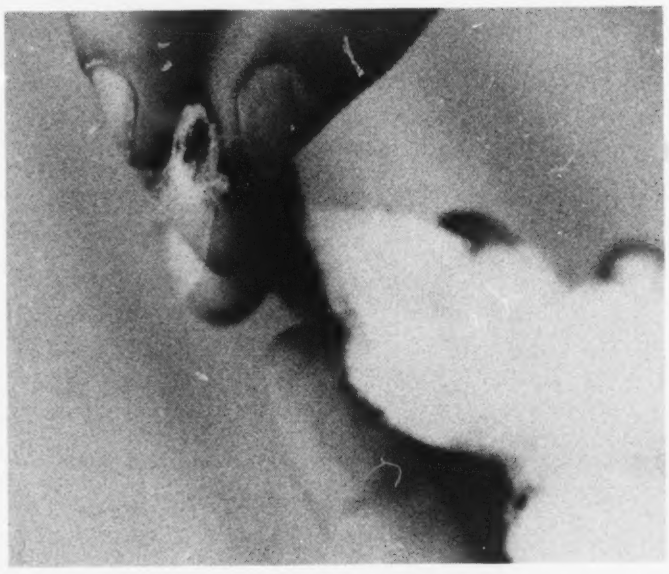


Fig. 51B-2. Removing Chaff

4. Wash the lint (the cotton fiber) which remains. Fill the shallow pan with about one pint of cleaning solution. Dip the cotton fiber into the fluid and agitate it gently. See Fig. 51B-3.
5. Remove the fibers and place them on paper towels to dry. See Fig. 51B-4.
6. While the fiber is drying, pour the cleaning solution back into its container, put on the stopper, and store it in a fireproof location.

Combing

7. After the fiber is dry, use the comb or brush to comb out the refined cotton into long, parallel strands. Short combing strokes should be used at first. As the cotton fibers become separated, longer strokes should be used. Try to make the fibers parallel. See Figs. 51B-5 and 51B-6.

Twisting

8. Twist the short strands into one long, continuous strand. Place the combed strands of cotton between the two abrasive blocks. See Fig. 51B-7. As you shuffle the blocks gently together in one direction, the combed fibers are formed into a continuous strand of yarn. See Fig. 51B-8. In producing the yarn, care must be taken to assure a uniform thickness. If during the twisting process the yarn becomes irregular in diameter, comb it back into strands of fiber and repeat the process.

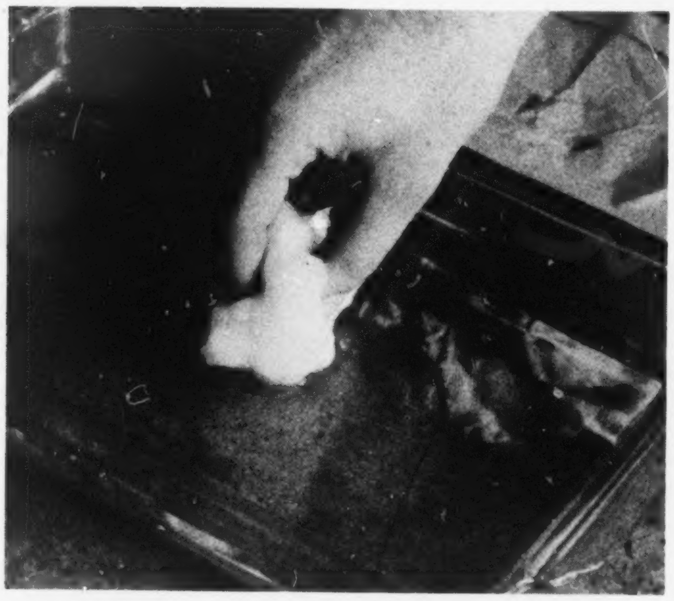


Fig. 51B-3. Dipping in Cleaning Fluid

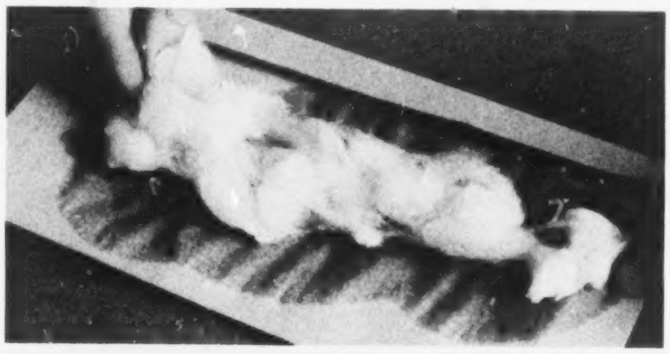


Fig. 51B-4. Removing Moisture

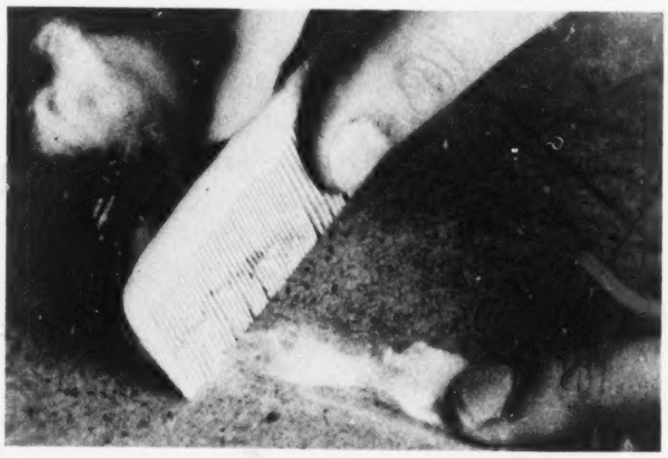


Fig. 51B-5. Combing Fibers

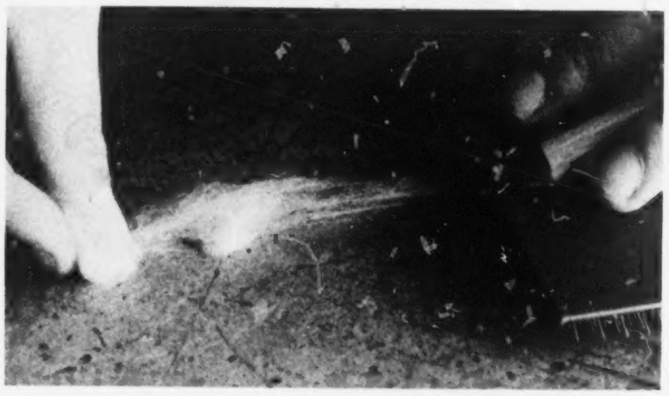


Fig. 51B-6. Brushing Fibers

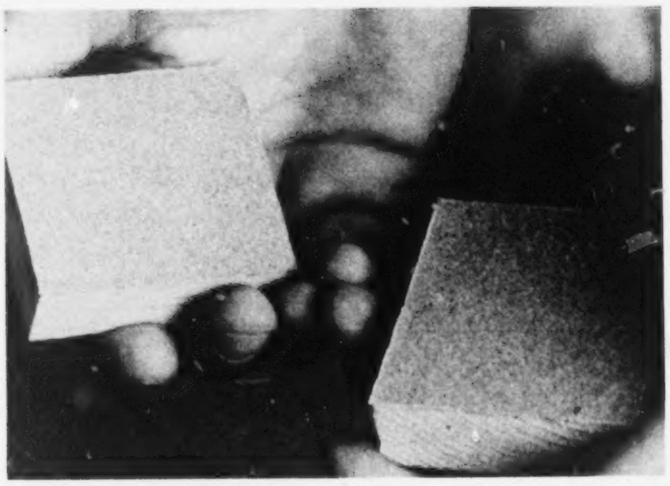


Fig. 51B-7. Abrasive Blocks

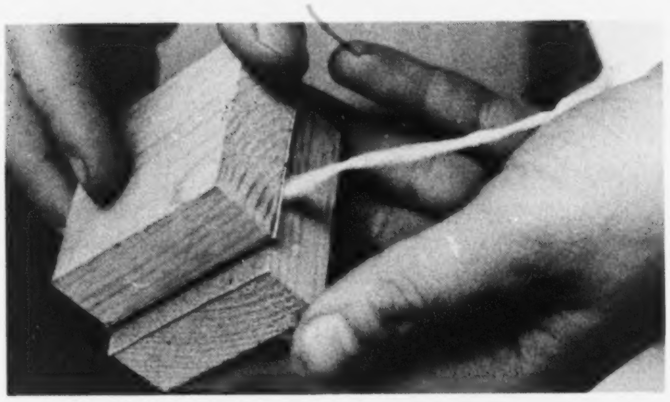


Fig. 51B-8. Twisting Fiber into Yarn

Collecting Standard Stock

9. As the continuous strand is produced, it must be collected on a spool. The cardboard mailing tube or dowel rod will serve as a spool. Coil the twisted yarn onto the spool.
10. Return all equipment and supplies to their proper location in the room. Dispose of chaff and waste paper.

Questions

1. The process of removing seeds and chaff materials from cotton is known as

   re________________.
2. Straightening out the fibers of cotton to produce parallel strands of fibers is known as

   co________________.
3. The forming of the combed fibers into a continuous strand of yarn is known as

   tw________________.
4. The seed pod of a cotton plant, which contains the fiber, is called a b____________.
5. Cotton f____________ is processed into yarn.

ACTIVITY 52

Story of Petroleum Products

Problem

Objective

Using one quart of contaminated oil, reprocess the oil by filtering, magnetic separation, and siphoning.

Equipment (Group of 5)

1	3″ dia. funnel
2	1000 ml. glass beakers
1	6″ bar magnet
1 pc.	flexible tubing for siphon
1 pr.	long-nosed pliers

Supplies (Group of 5)

1 pc.	4″ x 4″ cardboard
1 qt.	contaminated oil in quart jar (10W oil)
1 pc.	5″ x 5″ cloth
½ lb.	sand and gravel mixture
1	plastic sheet
1 pkg.	paper towels
1	12″ length of string

Safety

1. Glass jars are breakable.
2. Oil is difficult to remove from clothing.

Preparing to Work

1. Assemble with your group at your work station.
2. Obtain the equipment and supplies necessary for your activity. Spread the plastic sheet over the workbench.
3. Obtain the contaminated oil and shake it well. See Fig. 52-1.

Refining by Filtering

4. Place the piece of cloth into the funnel and add the sand and gravel mixture to the funnel. This will serve as the filter.
5. Place the funnel over the glass beaker. You may use a scrap piece of cardboard to support the funnel over the beaker.
6. Pour the oil into the funnel, a little at a time, until about half has been filtered. See Fig. 52-2. The oil will pass through the filter.

Magnetic Separating

7. Move the magnet slowly through the filtered oil. Any steel particles which are in the oil should be attracted to the magnet. See Figs. 52-3 and 52-4.
8. Wipe the metal particles off the magnet with a paper towel.
9. Allow the oil to stand in the glass beaker for about five minutes. While the oil is standing, discard the filter mixture and clean the magnet and funnel.

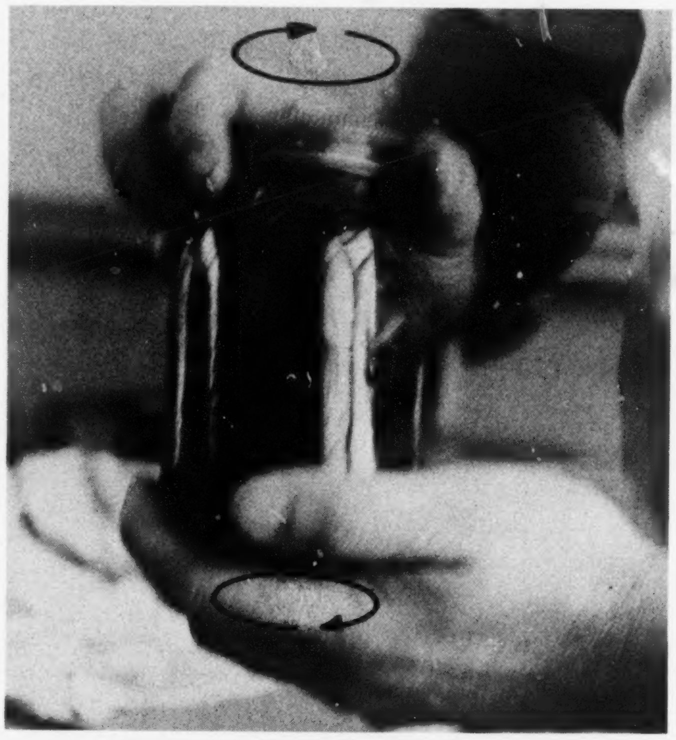


Fig. 52-1. Shaking the Oil

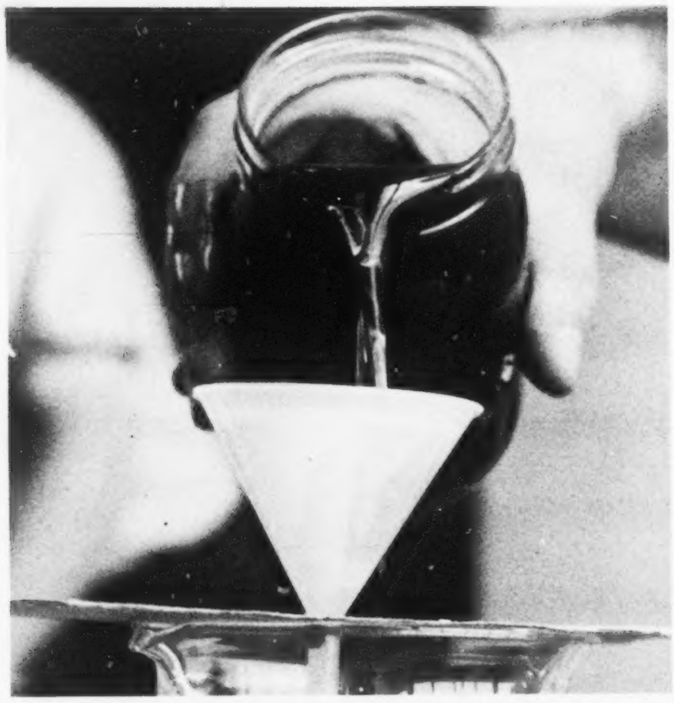


Fig. 52-2. Pour Oil into Funnel

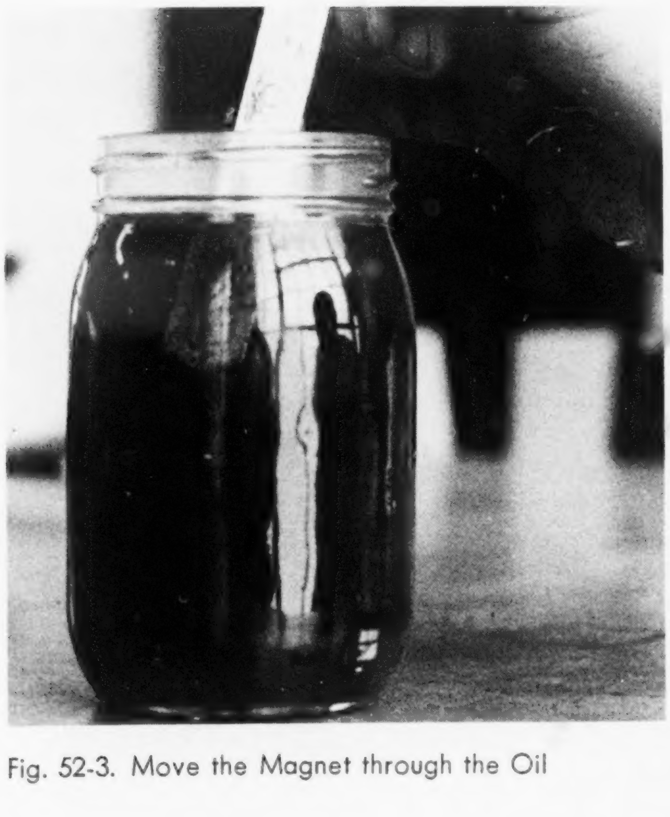


Fig. 52-3. Move the Magnet through the Oil

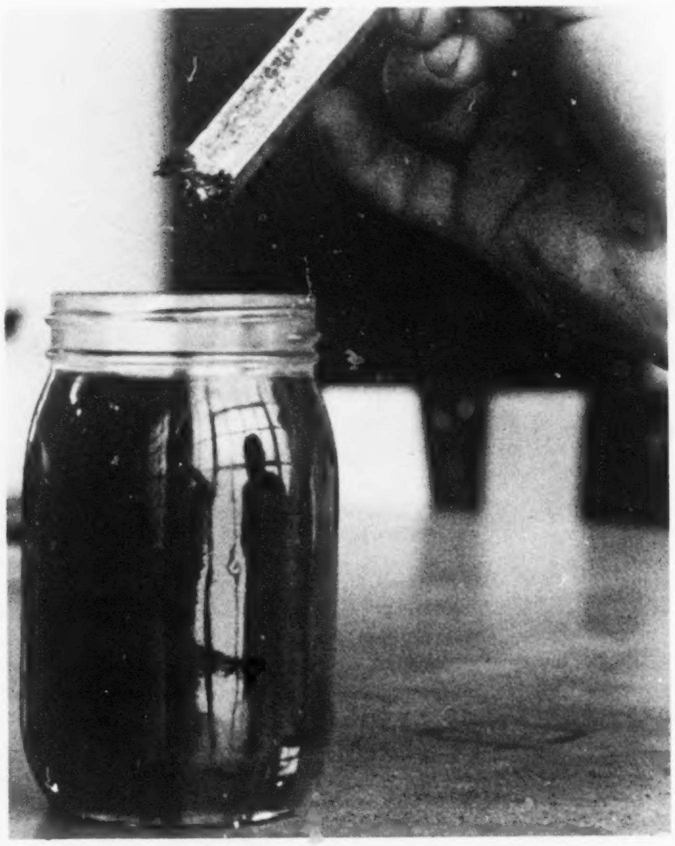


Fig. 52-4. Particles Attracted to Magnet

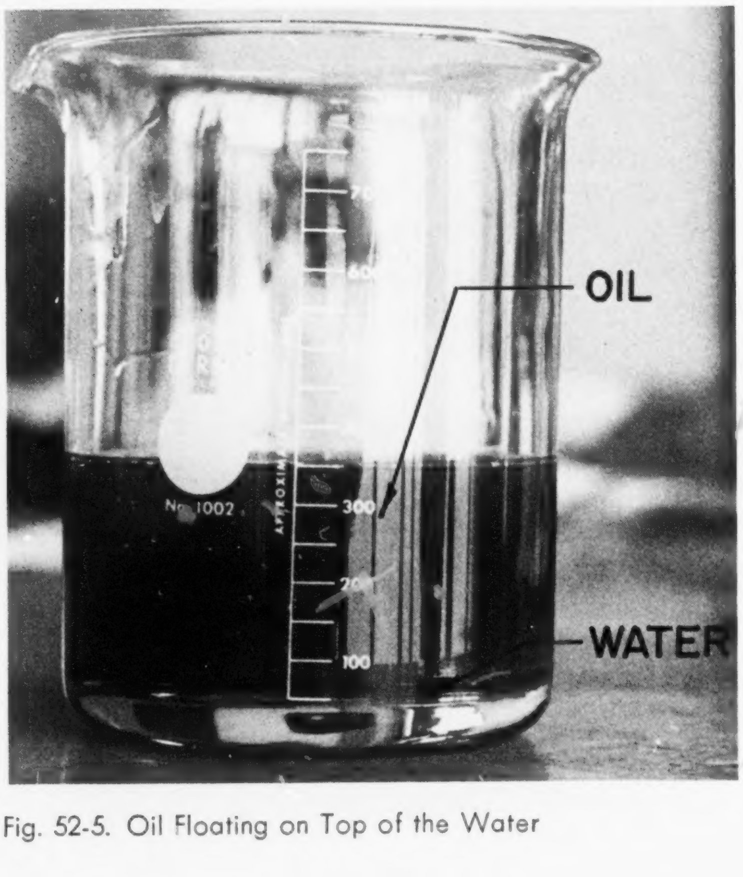

OIL
WATER
No. 1002
300
200
100

Fig. 52-5. Oil Floating on Top of the Water

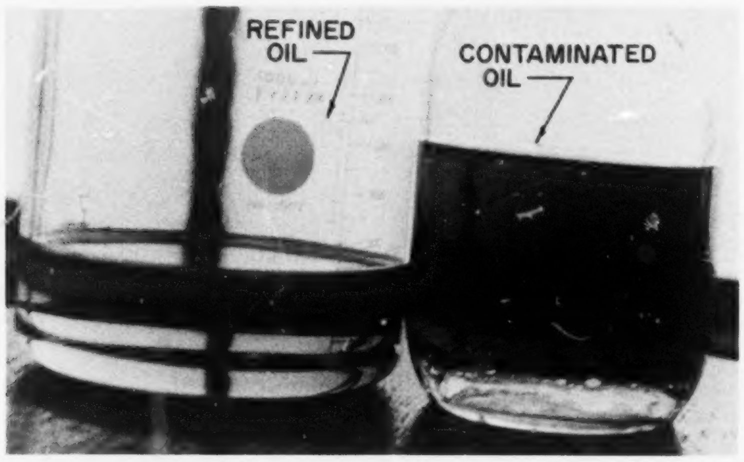


Fig. 52-6. Compare Refined Oil to Contaminated Oil

Separating Oil from Water

10. The oil will have risen above the water. The next step is to separate it from the water which is at the bottom of the oil. See Fig. 52-5. Siphon off the water into another beaker, as demonstrated by your teacher. Use the pliers to hold one end of the tubing closed when you insert it into the liquid.

Cleaning Up

11. Keep the beaker of refined oil and the beaker of contaminated oil at your work station. Return all other equipment and supplies to their proper location in the room and clean the work area.

12. You have now completed the refining process. Compare the refined oil with the remaining contaminated oil in the original container. See Fig. 52-6.

Questions

1. Using your senses of sight, smell, and touch, find four differences between the refined oil and the contaminated oil. In comparison with the contaminated oil, the refined oil . . .

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

2. Steel particles can be removed from contaminated oil by using a m____________.
3. Water will not mix with oil because it is heavier than the oil; it will settle b______________ the oil.
4. Oil never w______________ out, but becomes contamined and therefore must be refined.

ACTIVITY 53

Making Components by Forming or Separating Standard Stock

Today you will identify the stage of production shown in some pictures.

Problem

Objective

Referring to illustrations of manufacturing processes, identify the stage of production represented in each illustration.

Identifying Stages of Production:

1. Look at each illustration, Figs. 53-1 through 53-20.
2. On Fig. 53-21, check the stage of production you think is shown in the illustrations, Figs. 53-1 through 53-20.

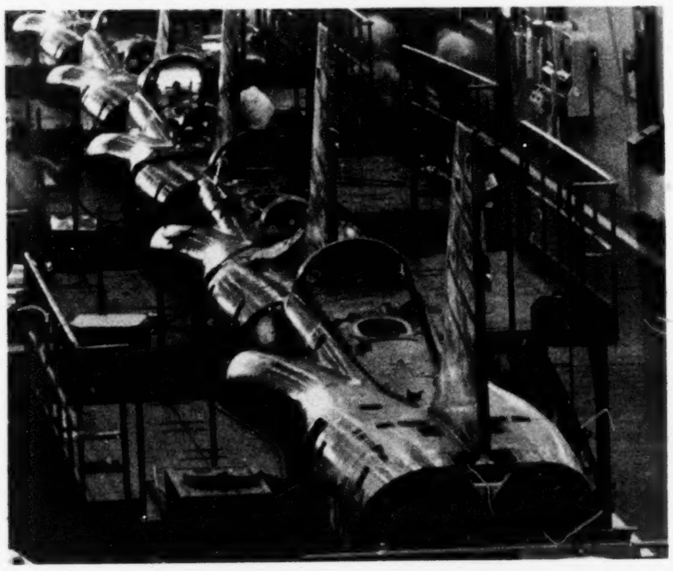


Fig. 53-1. Airplane Fuselage

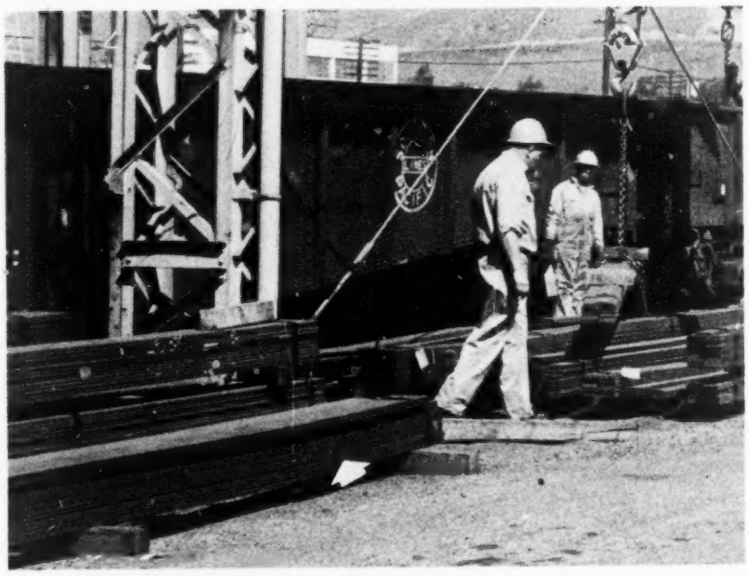


Fig. 53-2. Steel Plates in a Stack

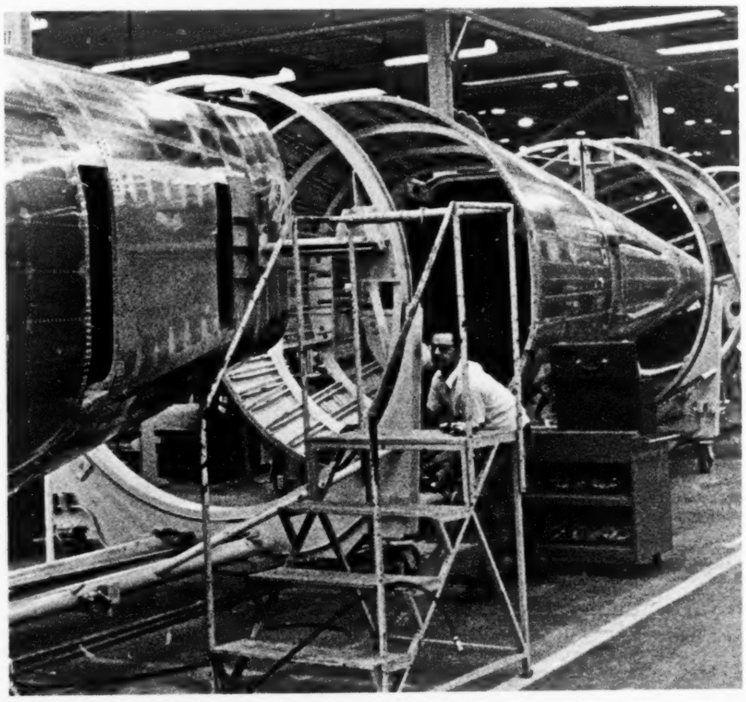


Fig. 53-3. Airplane Body

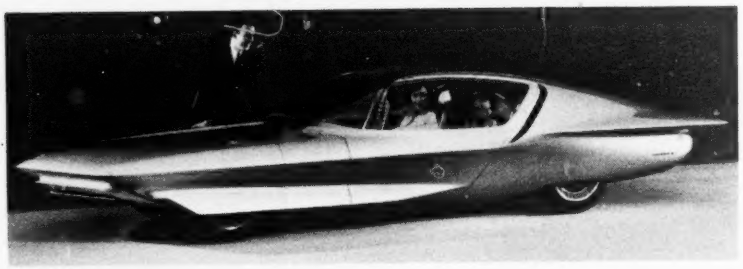


Fig. 53-4. New Car

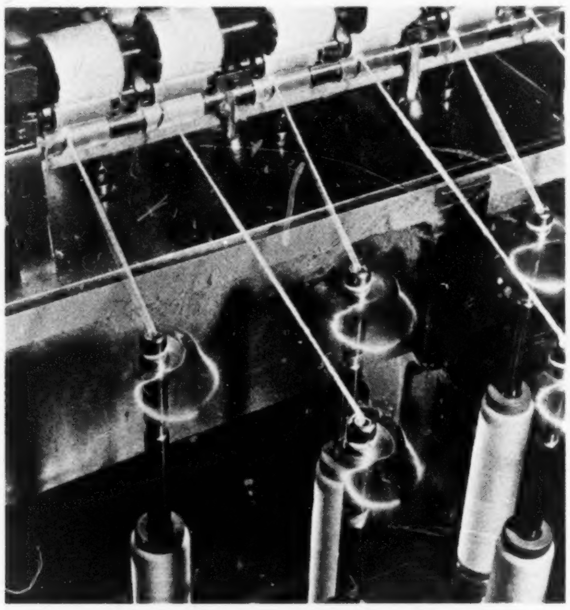


Fig. 53-5. Tire Core Thread and Fabric

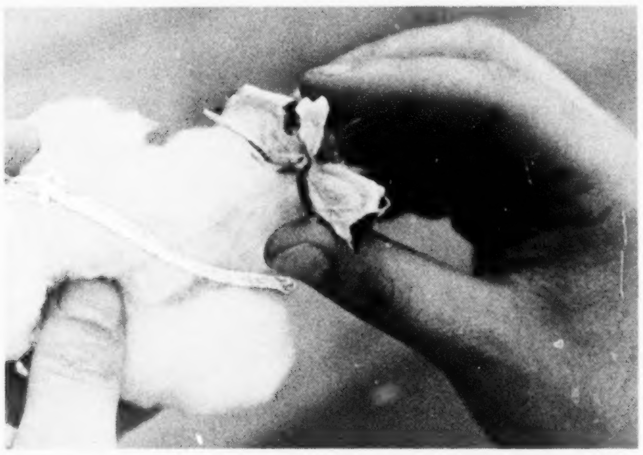


Fig. 53-6. Cotton Boll

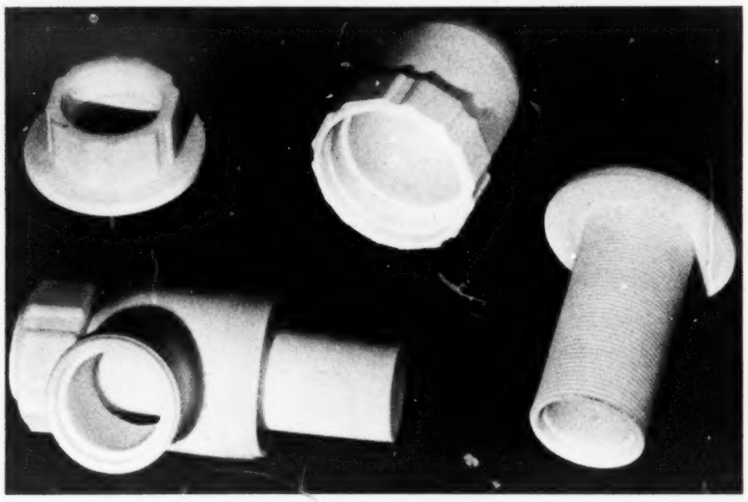


Fig. 53-7. Plastic Pipe Fittings

Fig. 53-8. Tapping Maple Trees for Sap

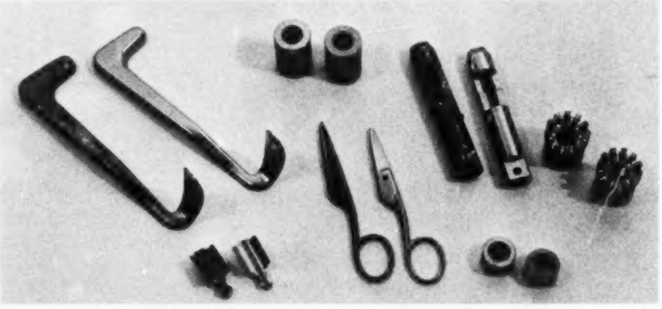


Fig. 53-9. Metal Castings

Fig. 53-10. Airplane

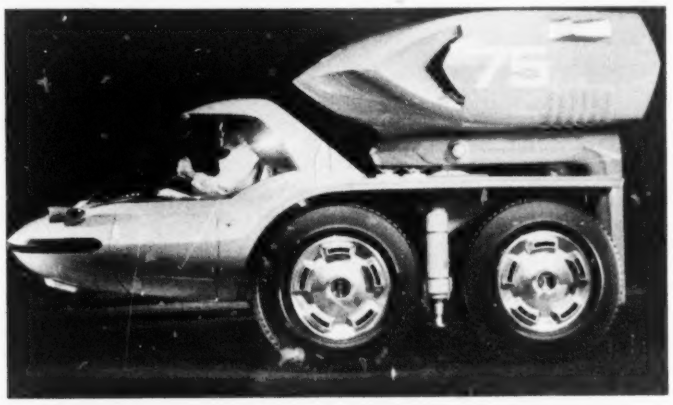


Fig. 53-11. Cab of a Tractor Trailer

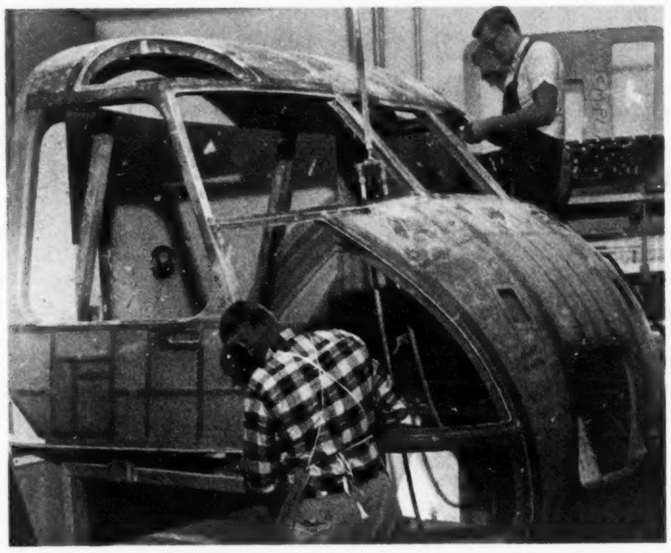


Fig. 53-12. Helicopter Cabin

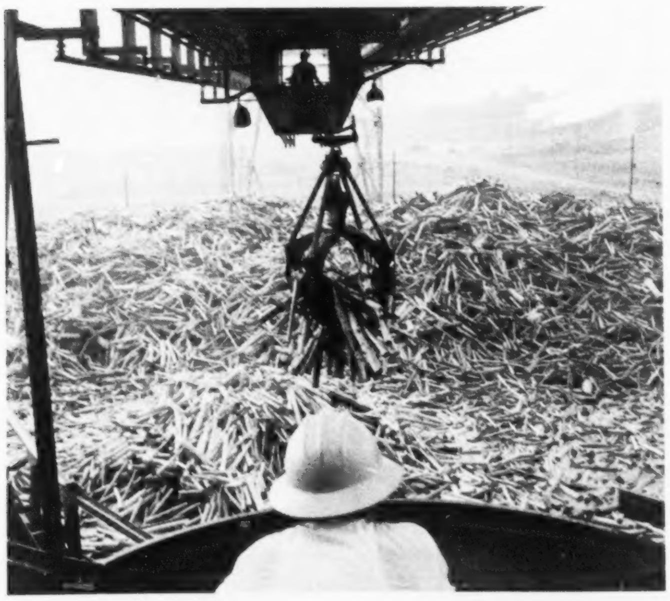


Fig. 53-13. Pulpwood Logs

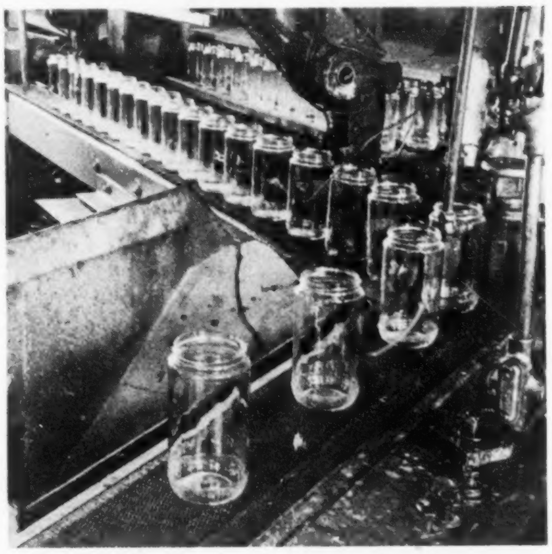


Fig. 53-14. Glass Jars

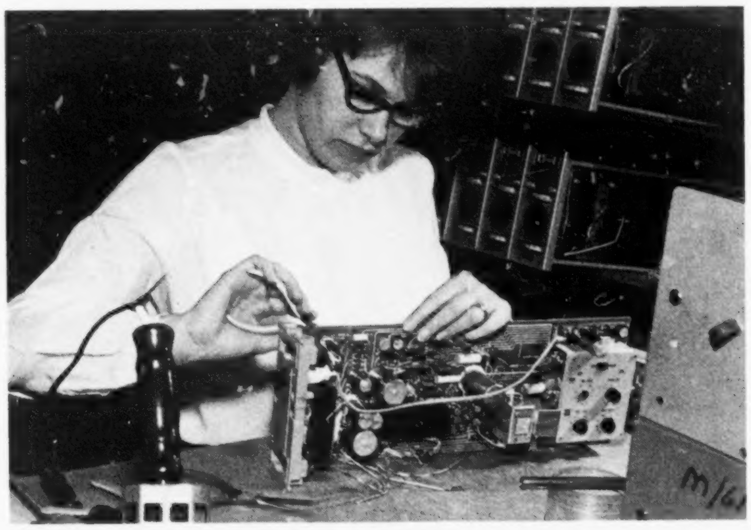


Fig. 53-15. Electronic Chassis

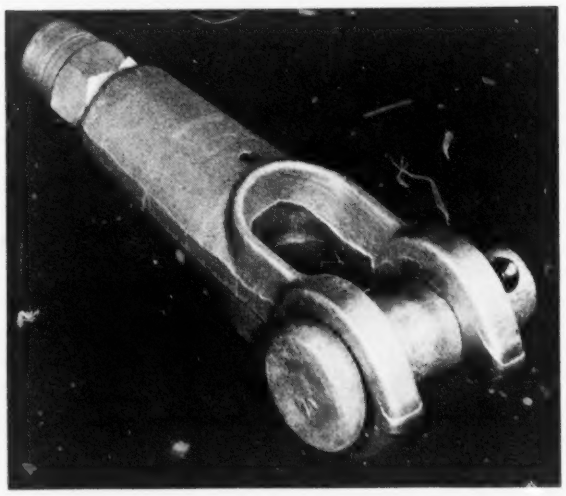


Fig. 53-16. Clevis Hitch

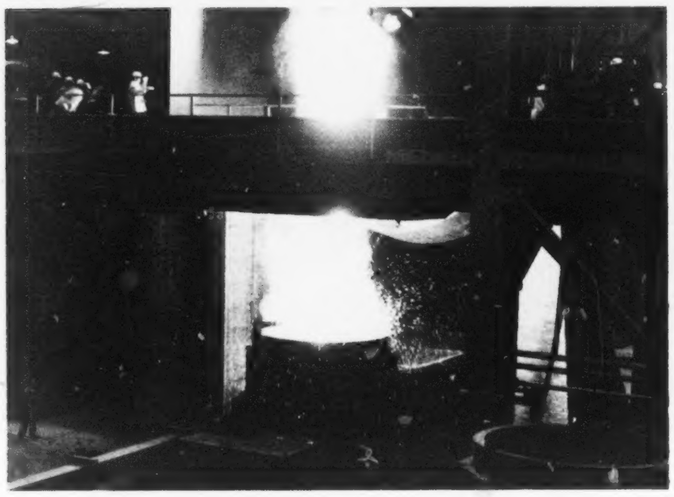


Fig. 53-17. Molten Steel

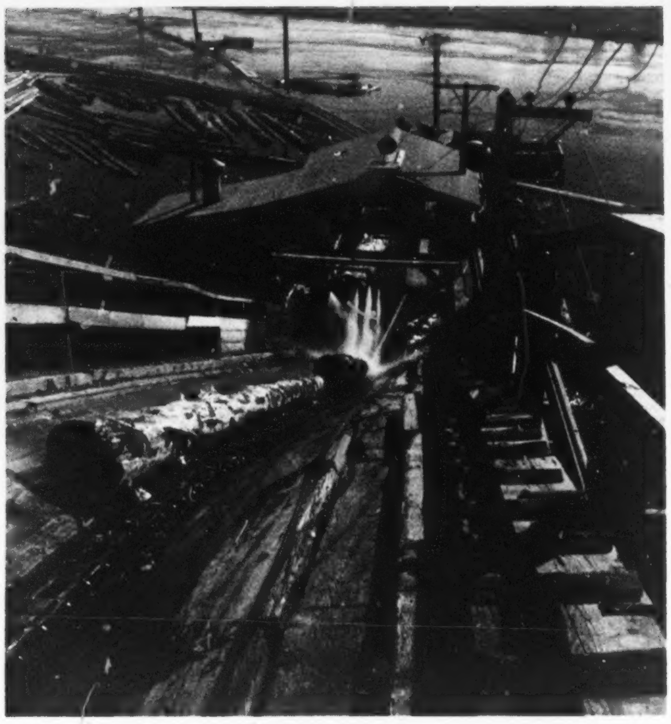


Fig. 53-19. Debarking Logs

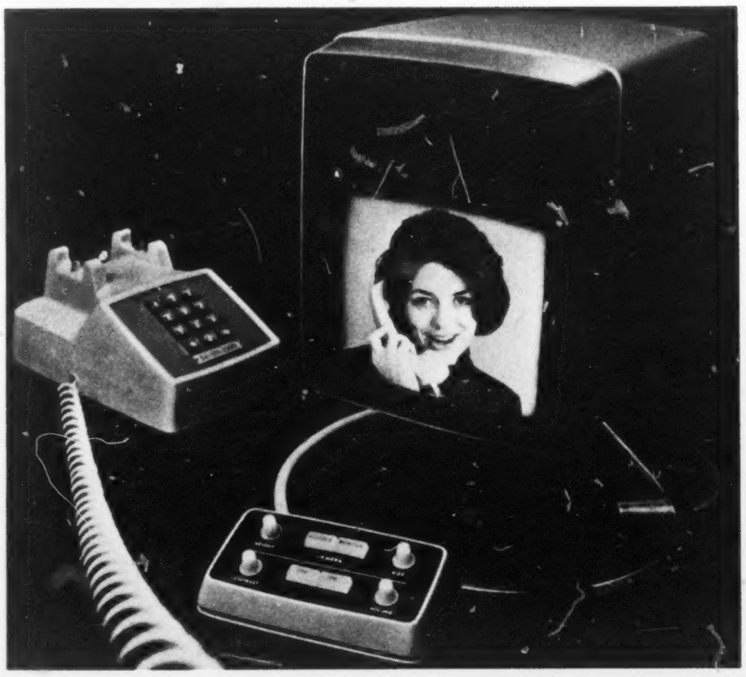


Fig. 53-18. Videophone

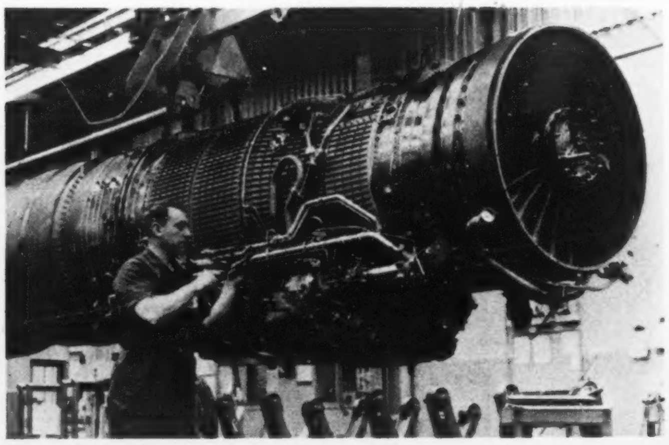


Fig. 53-20. Jet Engine

Fig. 53-21. Manufacturing Production Stages

	Figure Number																			
Production Stage	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Raw Material																				
Standard Stock																				
Component																				
Subassembly																				
Assembly																				

ACTIVITY 54

Material Forming Practices

Problem 1

Objective

Using proper equipment and supplies, draw-form a metal mold by *compressing and stretching.*

Equipment (Group of 5)

1 No. 95 draw die
1 plastic or rubber mallet

Supplies (Group of 5)

5 pcs. 2" x 2" 36 ga. soft aluminum foil

Preparing to Work

1. Meet with your regular group and obtain your supplies.

Draw-Forming

2. Load the die with one 2" x 2" blank of 36 ga. soft aluminum foil. See Fig. 54-1.
3. Hit the top once with a rubber mallet to draw-form the mold for casting plastic. See Fig. 54-2.
4. Lift up the top half of the die, remove mold by using the ejector mechanism, move it using a rotating motion. See Fig. 54-3.

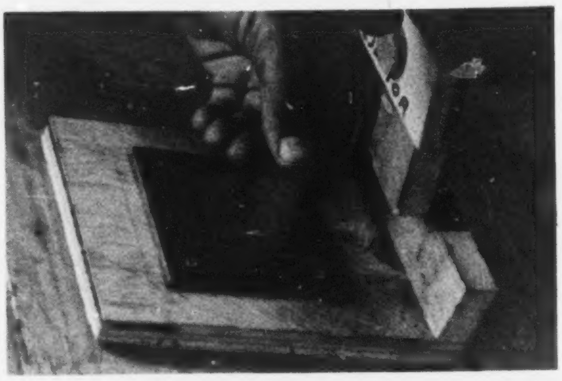


Fig. 54-1. Loading the Die

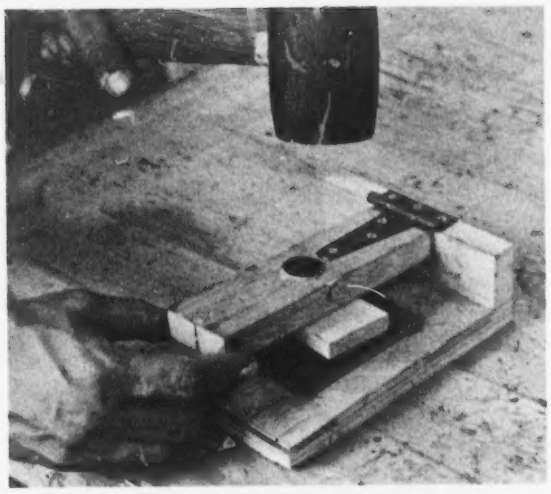
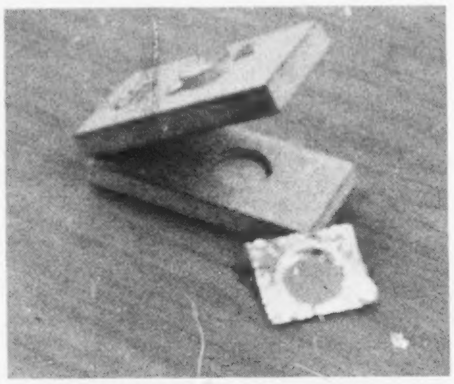


Fig. 54-2. Hitting the Die



This is the improved design for the draw-die fixture. This fixture is available in the official IACP equipment package from McKnight & McKnight Publishing Company.

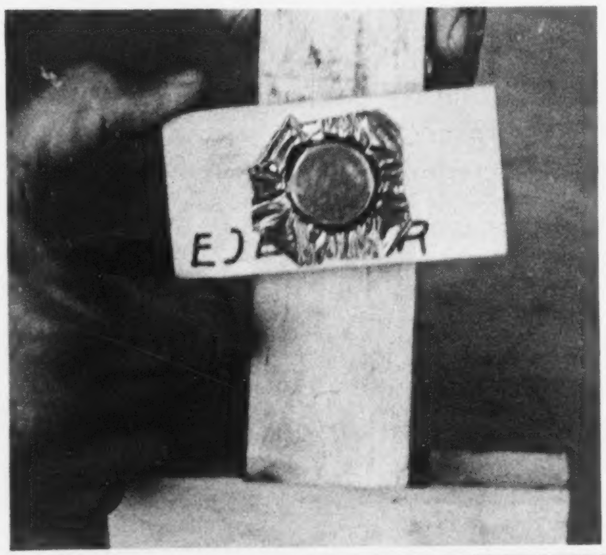


Fig. 54-3. Draw-Formed Mold

Problem 2

Objective

Using a draw-formed mold, cast resin and hardener into the mold and allow it to harden by conditioning.

Supplies (Group of 5)

1 qt.	liquid casting resin and hardener
1	stirring stick
1	3 oz. paper cup

Preparing to Work

1. Place the mold on the table.

> **Safety**
>
> a. Do not breathe fumes from resin and hardener.
> b. Your teacher should add the hardener to the plastic resin and mix them.
> c. If you get resin on your skin or clothes, wash with water.
> d. Keep plastic resin away from open flames.

Casting

2. Your teacher will supply your foreman with enough resin and hardener for your group.
3. After mixing, pour resin and hardener into mold. See Fig. 54-4. Fill the mold half-full.
4. Allow the mixture to *cure* for approximately 5 minutes.
5. When mixture has gelled, place object to be imbedded into the mold. See Fig. 54-5.
6. Your foreman will obtain additional resin and hardener from the teacher as it is needed.
7. Pour the additional mixture into the mold, and store as directed by the teacher. Your casting will require overnight to cure completely.
8. The equipment supervisor should return all equipment while you clean up your work area.

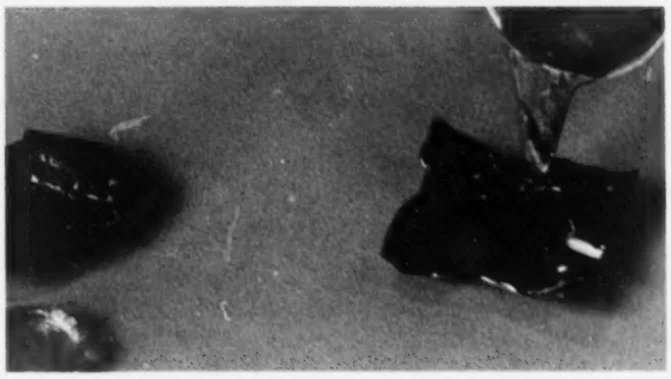


Fig. 54-4. Pouring the Resin

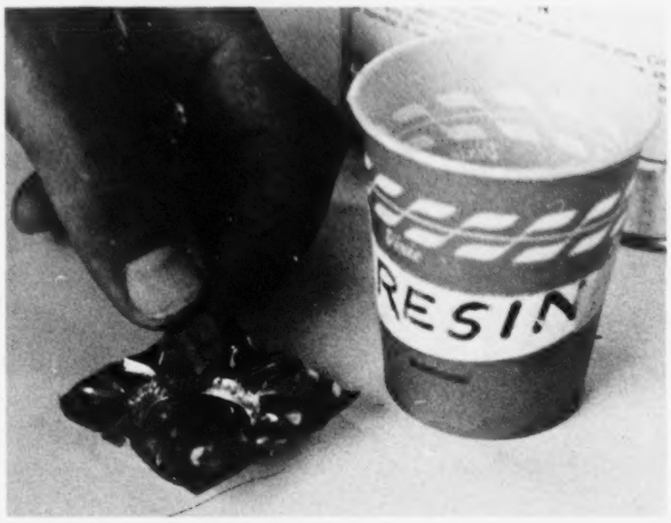


Fig. 54-5. Imbedding Object

Questions

1. A liquid poured into a mold is called a c __________.
2. Bending metal is a c ____________ and st __________ process.
3. A chemical reaction can be called a con __________ process.
4. All chemical reactions require heat.

   ______ Yes ______ No

ACTIVITY 55A

Casting or Molding

Today you will perform *permanent-mold casting* to manufacture several concrete bricks.

Problem

Objective

Using a permanent mold and the ingredients for sand-mix cement, cast four concrete bricks to demonstrate a *permanent-mold casting* process.

> **Safety**
>
> Do not mix or handle concrete with your hands.

Equipment (Group of 5)

2	brick molds
4 pcs.	¼" x 5" x 10" tempered hardboard, cover board
1	plastic tote tray
1	1 qt. measure
2	pointing trowels
1	plastic bucket

Supplies (Group of 5)

1 qt.	Portland cement
4 qt.	sand
½ qt.	water
1	1" brush
	used or new machine *or* cutting oil
1	plastic dropcloth *or* newspapers

Preparing to Work

1. Assemble with your group and obtain the needed equipment and supplies. The bucket should contain about three quarts of water for cleaning tools.
2. Spread the plastic dropcloth or newspapers over your workbench, then lay your equipment on the covering.

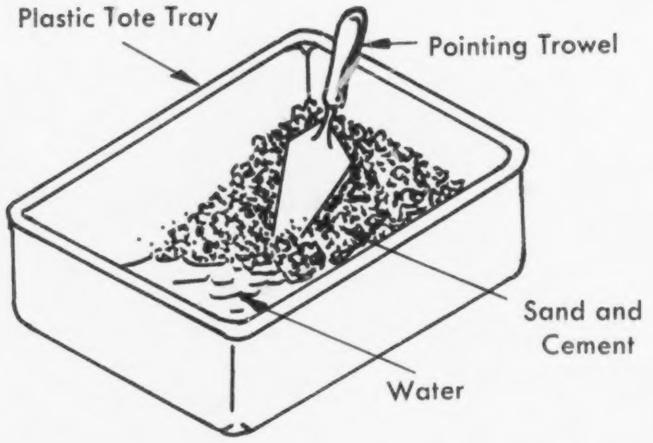


Fig. 55A-1. Mixing Concrete

Measuring the Cement

3. Place the sand and cement in the plastic tote tray.
4. Dry-mix sand and cement. *Do not* mix concrete with your hands.
5. Pour a small amount of water into the tray and mix with the pointing trowel.

   NOTE: Start mixing with water at one end, sand and cement at the other end. See Fig. 55A-1.
6. Continue adding water and mixing until the concrete is of uniform consistency. NOTE: *The mixture must be quite stiff.*
7. Oil the brick mold lightly with the 1" brush.

Pouring the Mold

8. Fill the brick mold with concrete. See Fig. 55A-2.

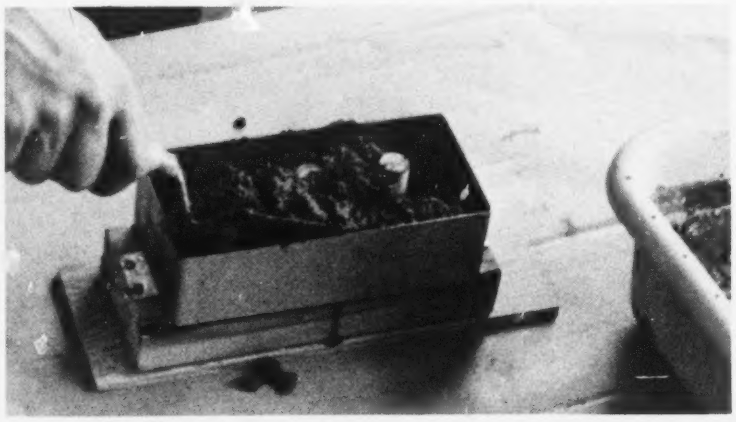


Fig. 55A-2. Filling Permanent Mold

9. Vibrate the mold by bouncing it lightly on the top of the workbench.
10. Smooth the top surface of the concrete with a trowel. Place the 5″ x 10″ cover board over the mold.
11. Hold the mold and cover board *tightly* together and turn over the mold with the cover board down. See Fig. 55A-3.

Removing the Mold

12. Place the mold in the designated curing area.
13. Carefully lift the mold up, leaving the formed brick on the cover board.

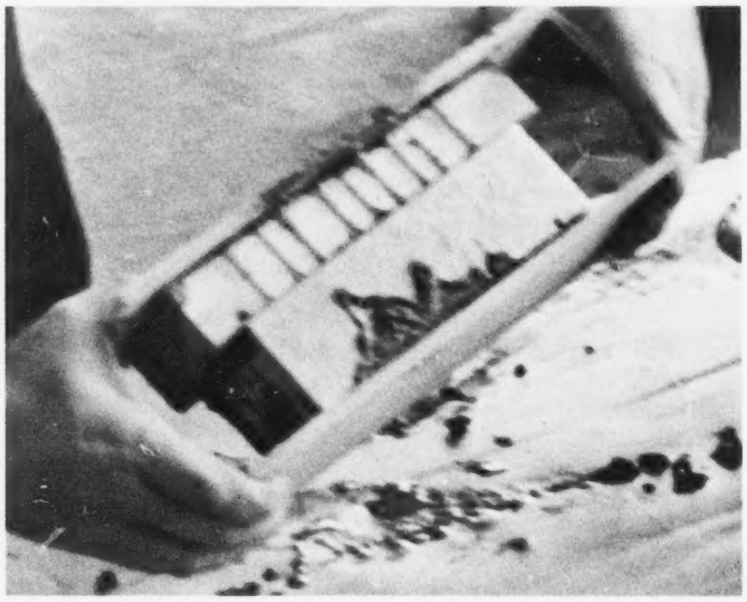


Fig. 55A-3. Turning Mold

Reusing the Mold

14. Return the mold to your work station.
15. Rinse the mold and trowel in the container of water at your station.
16. Repeat Steps 7 through 15. Make a total of four bricks.

Cleaning Up

17. After you have completed today's tasks, everyone clean up your equipment and the equipment supervisor will return it to the storage area.

Safety

Do *not* pour cement or concrete down any plumbing drain.

Questions

1. Heat must be applied to all materials in order to melt them before they can be poured into a mold.

    ______ Yes ______ No

2. Why is the manufacture of concrete bricks one of the permanent-mold processes?

    ____

    ____

    ____

ACTIVITY 55B

Casting or Molding

Today's discussion concerned various *casting* or *molding* processes. After discussing these ideas and viewing a demonstration of ramming up a *one-shot mold*, you are to answer questions about the major concepts of casting or molding and name some products made by using each process.

Problem

Objective

Using the information from the discussion and demonstration covering casting or molding, correctly answer four questions about the major concepts covered, and name two common products made by each of these molding processes.

Questions

1. In the *one-shot* molding process the mold is de__________ after the first use.
2. In the *permanent* molding process the mold is re__________.
3. The major *one-shot* molding processes are:
   a. sa__________ casting
   b. sh__________ mo__________ casting
   c. in__________ casting
4. The major *permanent* molding processes are:
   a. per__________ mo__________ casting
   b. d__________ casting
   c. in__________ molding
5. Name two products made by each of the following:
   a. *Permanent molds* that open
      (1) __________
      (2) __________
   b. *Permanent molds* that are upset to drop parts out
      (1) __________
      (2) __________
   c. *One-shot molds*
      (1) __________
      (2) __________

ACTIVITY 55C and D

Casting or Molding

Today you will ram up a sand mold to be used to form a mallet head. Your teacher will then pour metal to form a casting.

Problem

Objective

Using the proper equipment and supplies, ram an open cavity mold for sand casting.

Equipment (Group of 5)

1	trowel
1	foundry riddle
1	bench rammer
1	8″ x 10″ molding board
1	6″ x 8″ foundry flask
1	8″ x 10″ bottom board
1	spoon and gate cutter
1 pc.	½″ x ½″ x 12″ cold-rolled steel strike bar
1 pc.	2″ x 3″ tin plate, bent U-shaped, for cutting pouring basin
1	4 qt. bucket
1	molder's bellows (per class)
1 pr.	tweezers
1	½″ dia. x 6″ mild steel rod, rapping pin

Supplies (Group of 5)

15 lbs.	molding sand *or* Petro Bond
½ lb.	nonsilica parting dust in cloth bag *or* talcum powder
1	4′ x 4′ heavy plastic dropcloth
5 pcs.	patterns for mallet head 1″ dowel 2″ long
1	No. 8 2½″ wood screw
1	⅜″ polyethylene plastic tubing, 6″ long, split lengthwise as pattern for gating channels
3½ lbs.	type metal
½ oz.	AZ Flux

Preparing to Work

1. Equipment supervisor will obtain equipment and supplies. The foreman will assign jobs.
2. Fill the bucket with molding sand and carry it to your work area.
3. Spread the plastic dropcloth over your work area, so that it will be easier to clean up spilled sand.

Ramming the Flask

4. Place the flask upside down on the molding board.
5. Arrange the five patterns inside the flask with the screw holes *down*. See Fig. 55C-1.

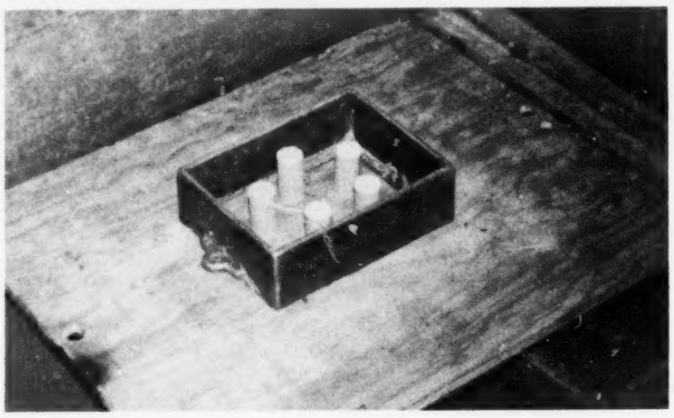


Fig. 55C-1. Arranging Patterns

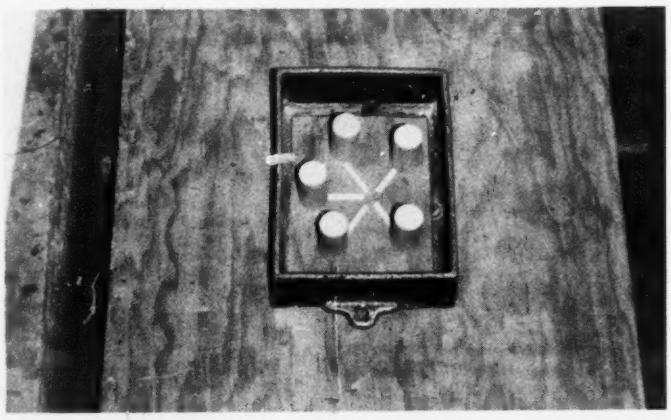


Fig. 55C-2. Place Gating

6. Cut and place five pieces of split tubing from patterns to approximate area of pouring basin. See Fig. 55C-2. These will be paths for gating.
7. Shake some parting compound over the patterns and split tubing. See Fig. 55C-3.
8. Using the riddle, sift at least one inch of sand over the patterns. If you use Petro Bond sand, it is not necessary to use the riddle. See Fig. 55C-4.
9. Press the sand around the patterns with your fingers. See Fig. 55C-5.
10. Fill flask with sand until it is piled above sides of flask. See Fig. 55C-6.
11. Use a bench rammer to ram the sand into the flask. See Fig. 55C-7.

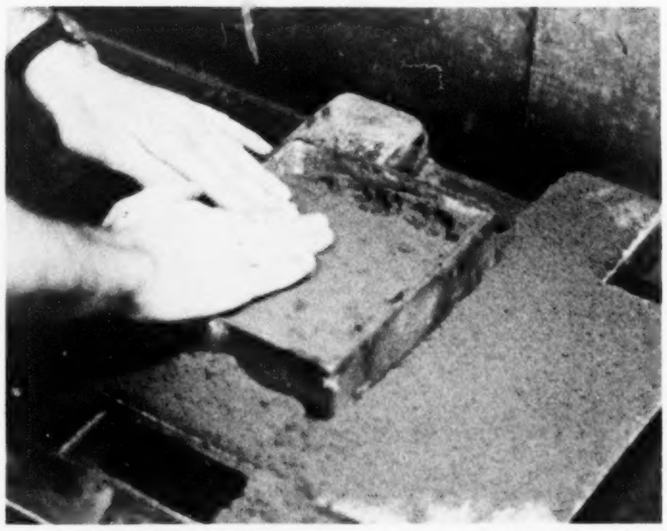


Fig. 55C-5. Packing Sand

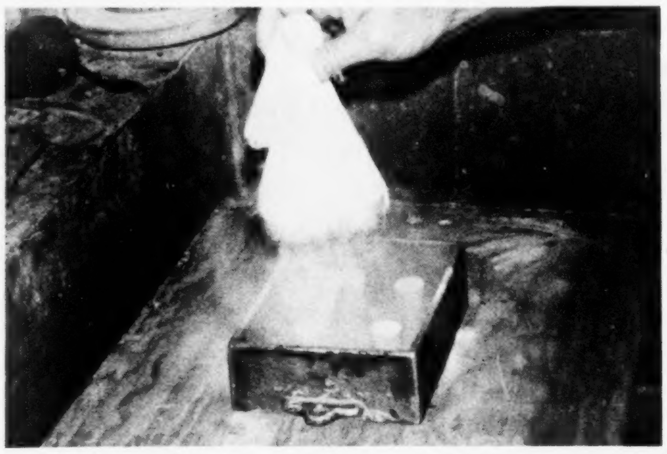


Fig. 55C-3. Parting Compound

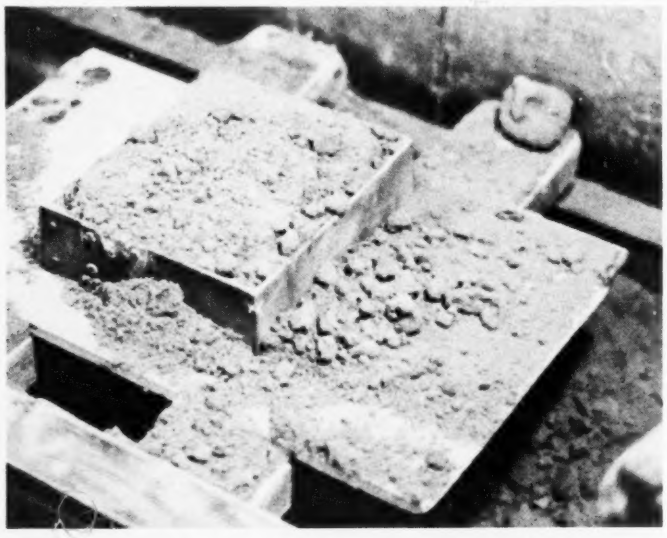


Fig. 55C-6. Filling Flask

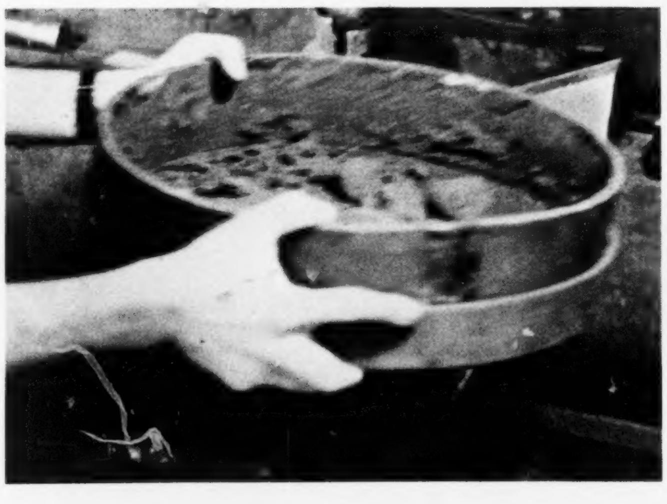


Fig. 55C-4. Riddling Sand

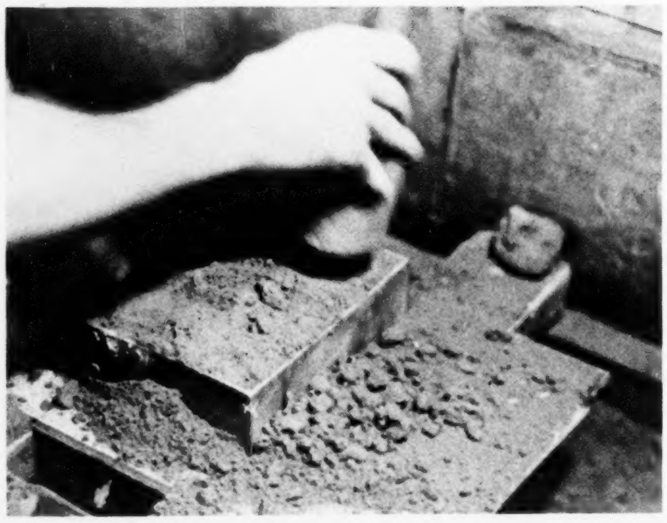


Fig. 55C-7. Ramming Sand

12. Smooth the top of the flask with a strike bar. See Fig. 55C-8.
13. Place the bottom board on top of the flask and upset the flask. See Fig. 55C-9.
14. Remove the molding board.
15. Use a trowel to make the surface smooth. See Fig. 55C-10.
16. Blow off all loose sand with a bellows. See Fig. 55C-11.
17. Use a pair of tweezers to lift the half-tubings from the flask. See Fig. 55C-12.
18. Cut pouring basin. See Fig. 55C-13.

Removing the Pattern

19. Twist the wood screw into the hole in the bottom of one pattern.
20. Use a small rapping pin to tap firmly all around the edge of the pattern. See Fig. 55C-14.
21. Slowly and carefully lift the pattern from the flask. See Fig. 55C-15.
22. Repeat Steps 19-21 for each pattern.
23. Repair all damaged areas with a spoon. See Fig. 55C-16.
24. Blow all loose sand from the flask and out of the mold cavities with a bellows.
25. Carefully carry the bottom board and the rammed mold to the designated pour area.

Safety

a. Wear safety glasses while pouring is being done.
b. Metal does not turn color when it changes from a solid to a liquid form.
c. Water on molten metal will cause it to splatter.
d. Water poured on hot metal will turn to steam, which may cause burns.
e. Do not blow sand into face or eyes of other students or yourself with bellows.

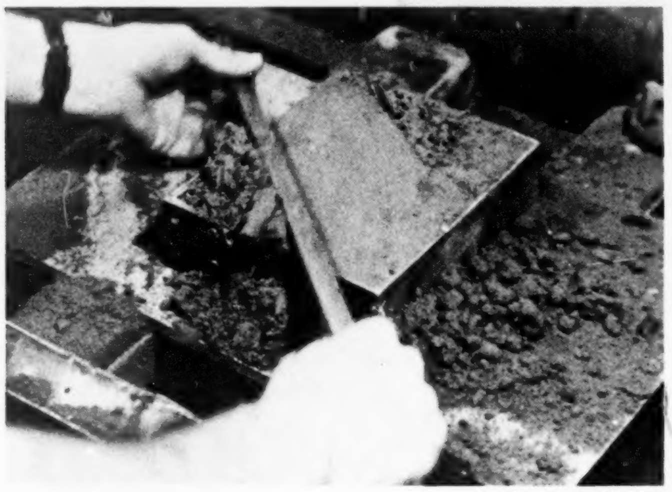


Fig. 55C-8. Striking-Off

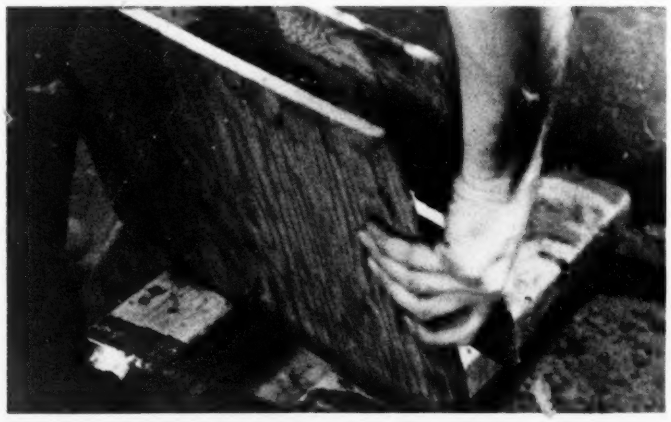


Fig. 55C-9. Upsetting Flask

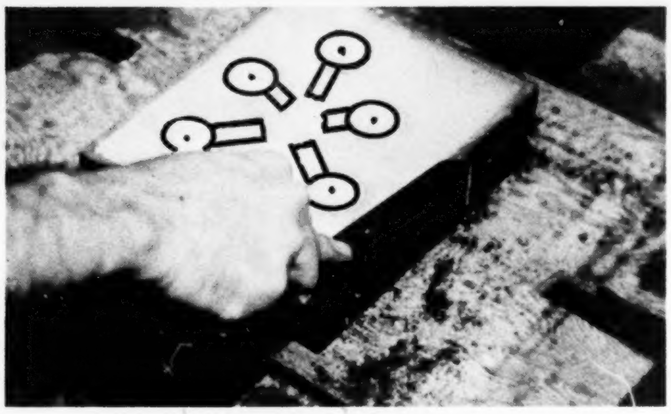


Fig. 55C-10. Smoothing Surface

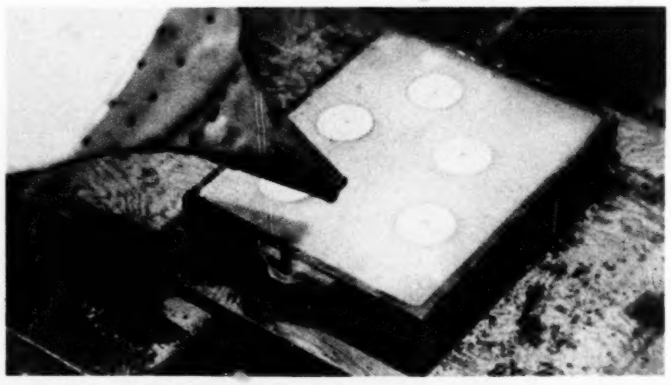


Fig. 55C-11. Removing Loose Sand

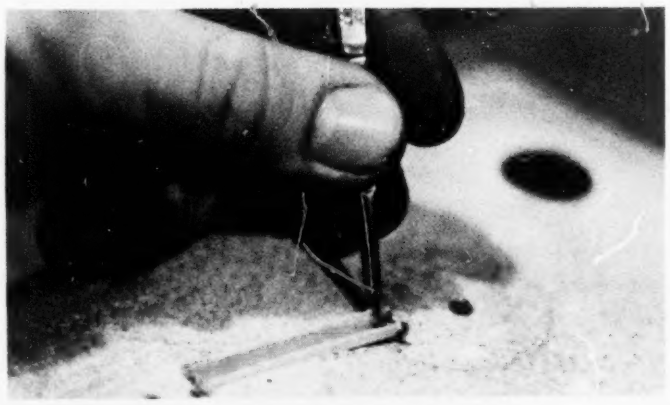


Fig. 55C-12. Removing Half-Tubes

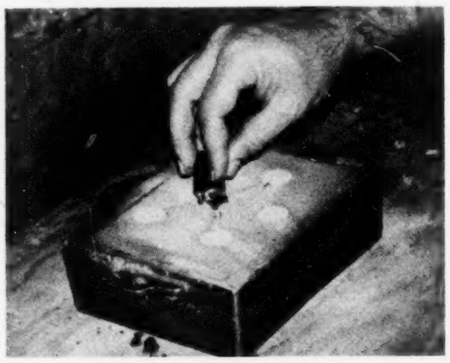


Fig. 55C-13. Pouring Basin

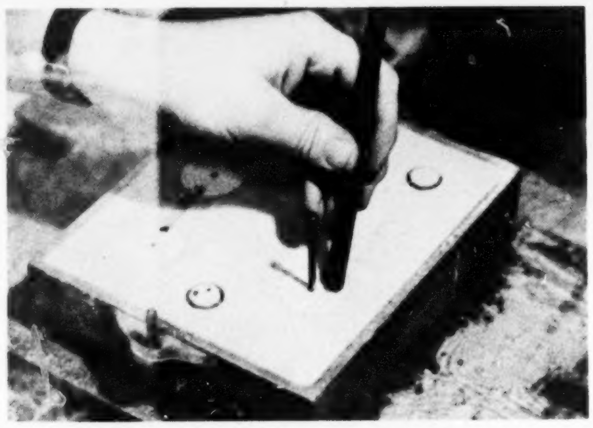


Fig. 55C-14. Rapping Pattern

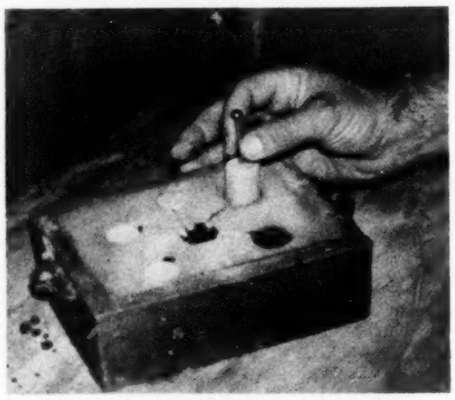


Fig. 55C-15. Pulling Pattern

Pouring the Mold

26. *For safety reasons, your teacher will pour the molten metal.*

Removing the Castings

27. When the metal has cooled and hardened, remove the group of castings from the mold. See Fig. 55C-17.
28. Mark and store castings as instructed by the teacher.

Cleaning Up

29. Clean up your work area and return all equipment and supplies.

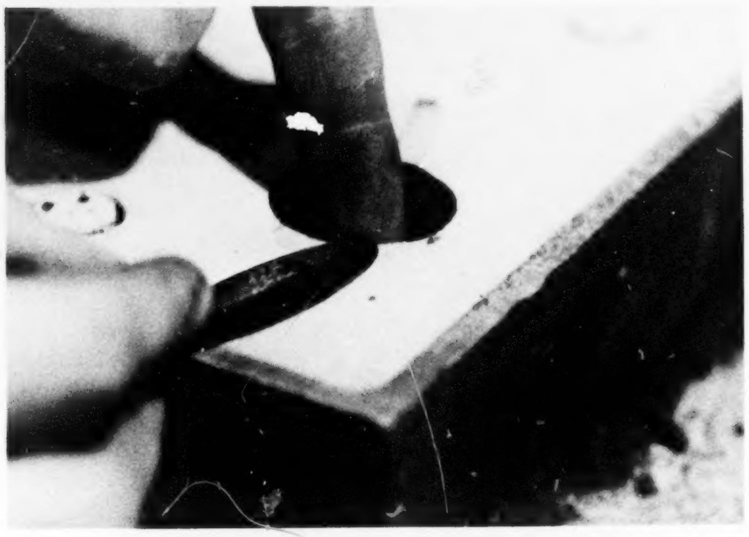


Fig. 55C-16. Repairing

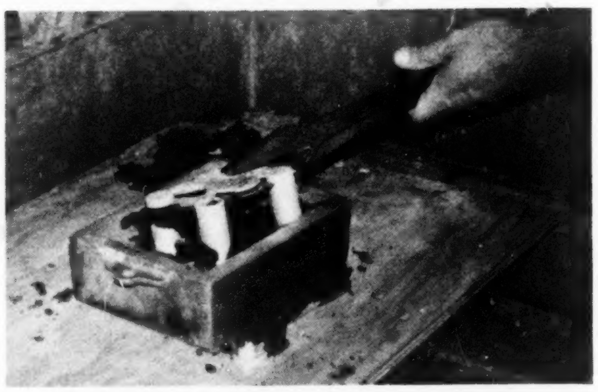


Fig. 55C-17. Removing Castings

ACTIVITY 56A

Compressing or Stretching

Today, you will vacuum-form styrene plastic sheeting and perform a compression-molding operation.

Problem 1

Objective

Using a plan of procedure and the necessary equipment and supplies, vacuum-form to shape any objects available to you such as a key, coin, nut or bolt.

Equipment (Class)

2	vacuum-forming boxes
2	250-watt infrared heat lamps
2	outdoor floodlight sockets, mounted on upright stands
4	2 ½″ No. 3 bulldog clips
1	vacuum sweeper with hose
1	small pocket type object such as a key or a coin, etc.

Supplies (Group of 5)

5 pcs. 6″ x 6″, .020-gage styrene plastic sheeting, .010 if available

Preparing to Work

1. Assemble with your group at your work station.
2. Get the supplies.

Safety

a. All students must wear goggles in the area of the heat lamps.
b. Do not touch heat lamp.

Vacuum-Forming

3. Clamp the styrene plastic in the forming frame. See Fig. 56A-1.
4. Place the object in the vacuum mold, as in Fig. 56A-1.
5. Lay the styrene over the mold, and set the mold under the heat lamp. See Fig. 56A-2. *The heat lamp is hot enough to burn you if you touch it.*
6. After about sixty seconds, the styrene will be soft enough to work. Insert the vacuum sweeper hose against the hole in the mold and start the sweeper motor.
7. After the plastic draws down over the object, *move the mold from under the heat lamp while the sweeper is still drawing.*
8. Remove the formed object from the frame.

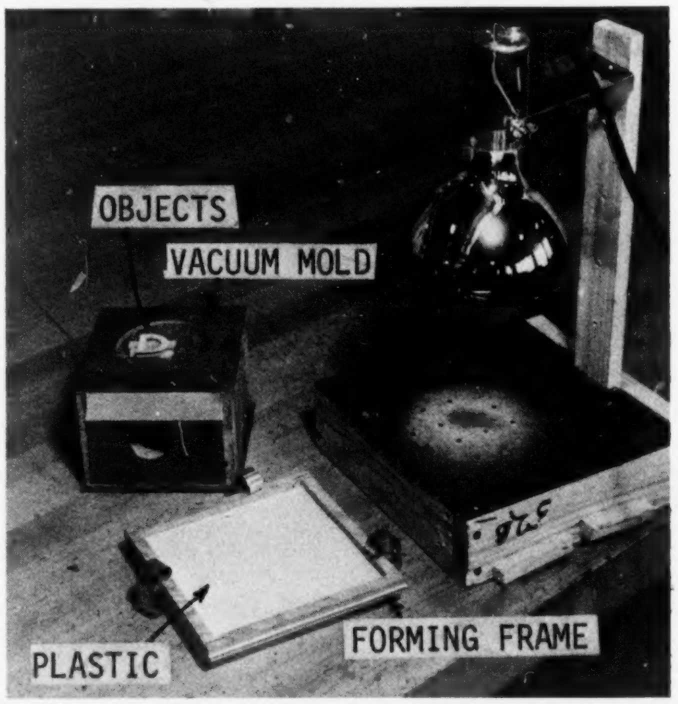


Fig. 56A-1. Preparing an Object for Forming

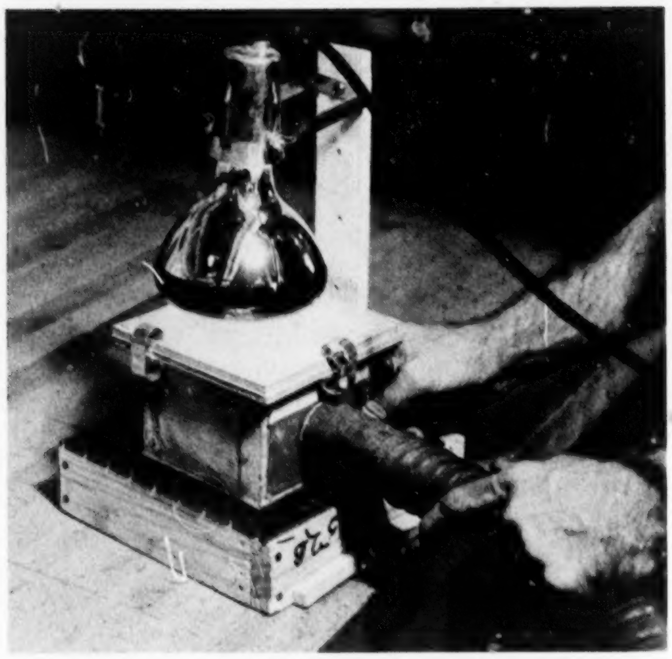


Fig. 56A-2. Attaching Vacuum

Problem 2

Objective

Using the necessary equipment and supplies, perform a compression-molding operation.

Equipment (Group of 5)

1 compression-molding kit

1 vise and vise guards

Supplies (Group of 5)

1 cup wood chips *or* sawdust

Preparing to Work

1. Get your equipment and supplies from the equipment supervisor. Take them to your work station.

Compression-Molding

2. Loosely fill the small pipe with sawdust.
3. Place a ramming rod in each end of the pipe.
4. Position the three pieces in a vise and slowly tighten the vise. See Fig. 56A-3.
5. Open the vise and remove the compression kit.
6. Remove the ramrod from the recessed end (larger diameter end) and force the remaining ramrod through the barrel to remove the pellet.
7. Observe the compressed part.

Questions

1. Squeezing particles into a solid is called

   c______________ molding.

2. In most industrial processes in which particles are compressed into solids,

   h____________ is combined with pressure

   to make the part hard and strong.

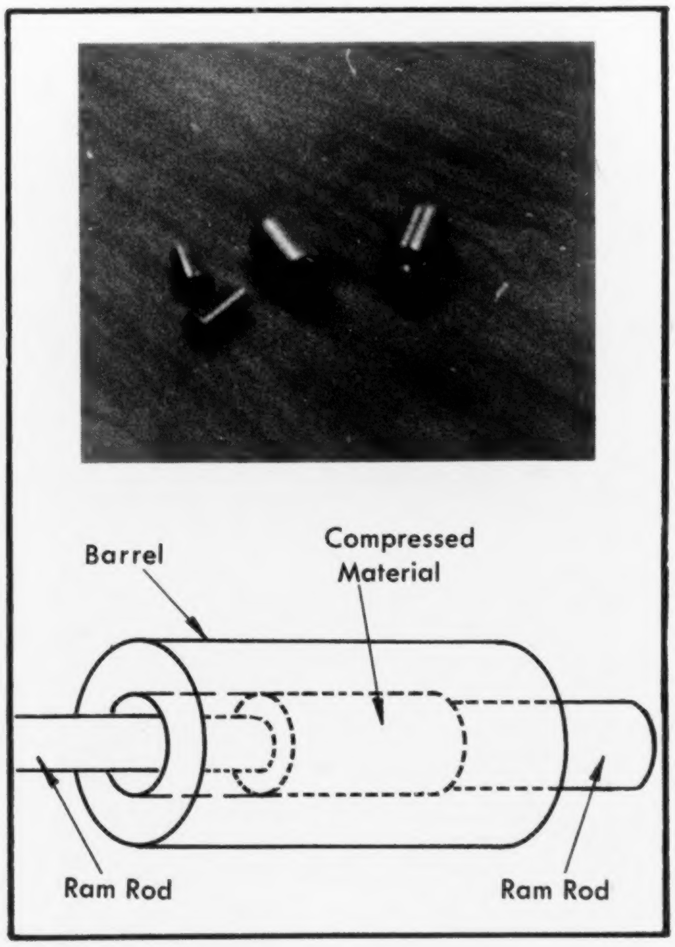


Fig. 56A-3. Kit in Vise

ACTIVITY 56B and C

Compressing or Stretching

This activity involves shaping a screwdriver blade by forging and filing.

Problem

Objective

Using drill rod and the proper equipment, forge the blade of a screwdriver and then file it to a finished shape.

Equipment (Group of 5)

1	anvil *or* equivalent
1	propane torch with blowtorch head
2	13 oz. ball peen hammers
2 prs.	vise grips (wrenches) *or* multi-groove joint pliers
3	10″ smooth mill files
2 prs.	asbestos *or* welding gloves
5 prs.	safety glasses
1 set	vise jaw covers

Supplies (Group of 5)

5 pcs.	$\frac{3}{16}$″ dia. x 6″ drill rod
	10″ masking tape

Preparing to Work

1. Assemble with your group of five. The equipment supervisor should get the needed equipment and supplies while the foreman assigns jobs.

Safety

a. Wear safety glasses.
b. Wear asbestos or welding gloves.
c. Use caution when working with a propane torch.

Hot Forging

2. Light the propane torch.
3. Put on the asbestos gloves.
4. Hold the piece of material with the pliers or vise grips.
5. Hold the end of the rod in the propane torch flame and heat the rod to a cherry red color. See Fig. 56B-1.
6. Hold the material on top of the anvil and hammer the hot end to shape as follows:
    a. Strike it several times, forming a tapered flat end.
    b. Turn it over and continue the hammering operation. See Fig. 56B-2.
    c. If the metal cools, reheat it to maintain the cherry red color.
7. CAUTION: Let the piece cool slowly in the air. *Do not put it in water.* (Chilling rapidly in water hardens the metal so it cannot be filed.)

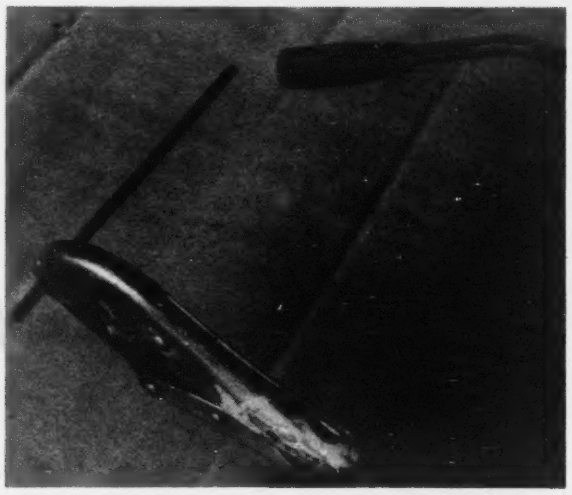


Fig. 56B-1. Heating

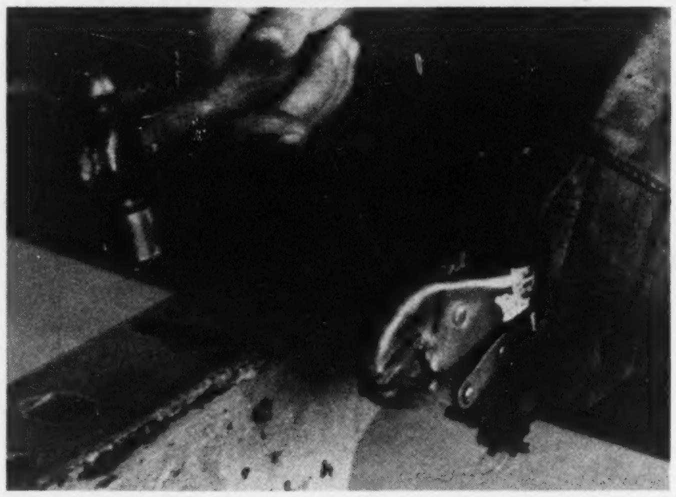


Fig. 56B-2. Forging

Filing

8. After the metal has cooled, put it in the bench vise with vise jaw guards and file it to shape using the fine-tooth mill file. See Fig. 56B-3.
9. On the handle end, file three notches about 1″ from the end. Opposite the notches, file the rod so that there is a flat side. See Fig. 56B-3. This will provide an air space when the handle is combined.

Cleaning Up

10. Use masking tape to label your blade, and the timekeeper will return it for storage.
11. The equipment supervisor will return all equipment and supplies. Clean the work area.

Questions

1. How did you make the screwdriver blade malleable—capable of being shaped with a hammer?

   By h______________.

2. What type of force did you use in forging the screwdriver blade?

   h______________.

3. You also shaped your screwdriver blade by using a f____________.

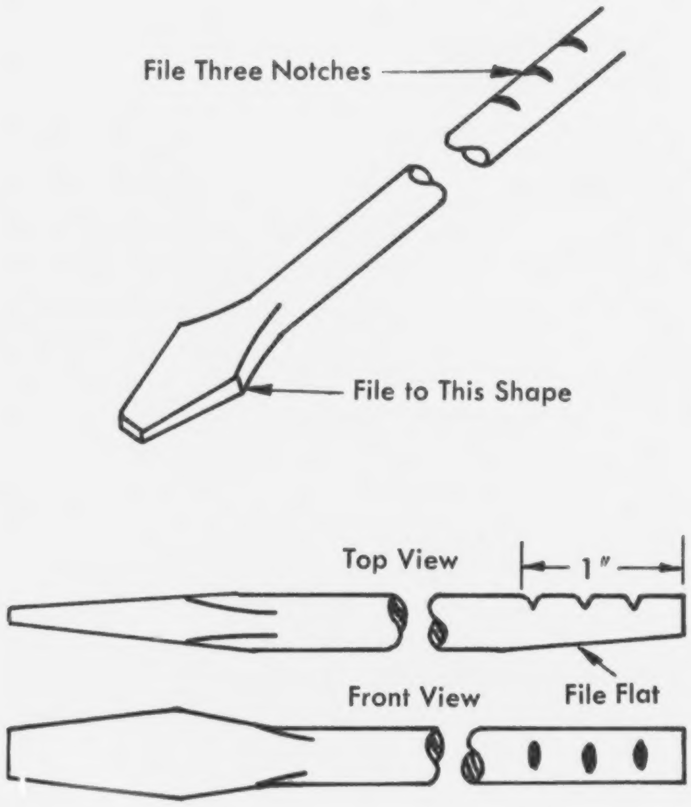


Fig. 56B-3. Filing to Shape

ACTIVITY 57A

Conditioning Material

Problem

Objective

Using a suitable mold and mixture of coating resin and hardener, pour the mixture into the mold to form a screwdriver handle.

Equipment (Class)

1	8 oz. measuring cup
1	test tube rack, optional
5	fine point felt pens

Supplies (Group of 5)

5	20 x 150mm. disposable glass culture tubes
1 pc.	masking tape, approx. 10″
½ oz.	btl. transparent dyes, assorted colors
	resin mixture, hardener, catalyst, provided by teacher

Preparing to Work

1. The equipment supervisor should get the supplies.
2. *Print* your name on a small piece of masking tape.
3. Measure up exactly 4¼″ from the bottom of a test tube, and wrap the tape to the glass at that point.
4. Place the test tube in a rack, as directed by your teacher.

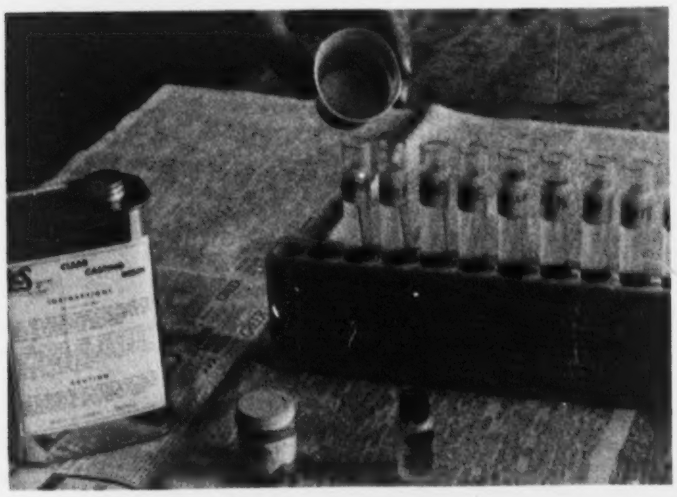


Fig. 57A-1. Pouring Resin

Safety

a. Make sure your room is properly ventilated: exhaust fans on and windows open.

b. Wash your hands with water if you should get any resin on them.

Casting

5. You will pour 1½ oz. (or to a depth of 4¼″) of clear or dyed plastic resin into your test tube mold. See Fig. 57A-1.
6. Store the filled test tube in the designated curing area.

Cleaning Up

7. Return all equipment and clean up the work area.

Questions

1. Conditioning changes the internal form or structure of a material.

   ______ Yes ______ No

2. A chemical reaction can be a

   con ______________ process.

3. The hardening of a thermosetting plastic

   is a ch ______________ reaction.

4. Some chemical reactions require heat.

   ______ Yes ______ No

5. List three conditioning processes that are classified as chemical-reaction processes.

   ____

   ____

   ____

6. The agent that speeds up the hardening process is called a c ______________.

ACTIVITY 57B

Conditioning Material

Today you will harden a screwdriver blade by thermal-conditioning.

Problem

Objective

Using the necessary equipment and supplies, thermal-condition a screwdriver blade by heat-treating and quenching.

Equipment (Group of 5)

1 pr.	vise grips or pliers
1	propane torch
1 can	quenching oil, 6 oz.
1 pr.	asbestos or welding gloves

Supplies (Per student)

1	hot forged and filed standard screwdriver blade
1 pc.	3″ x 3″ wet or dry sandpaper, 200 grit
1 pc.	fine emery cloth

Preparing to Work

1. Meet with your regular group and the equipment supervisor will obtain the needed equipment and supplies.
2. You will share equipment. The foreman of your group should indicate the order in which you will perform the activity.
3. Your teacher will light your propane torch when you are ready to begin thermal-conditioning.

Safety

The safety supervisor should enforce these precautions:

a. Wear safety glasses when heating metal.
b. Wear asbestos or welding gloves when heating metal.
c. Use pliers to handle hot metal.
d. Handle the propane torch carefully.
e. Make sure your room is properly ventilated.

Heat-Treating

4. Hold the blade in vise grips or pliers. See Fig. 57B-1.
5. Heat it with the propane torch until the *blade* end becomes a bright cherry red color. This color physically indicates that the metal has reached a critical temperature and is ready for treating.
6. Pass the torch to the next student.

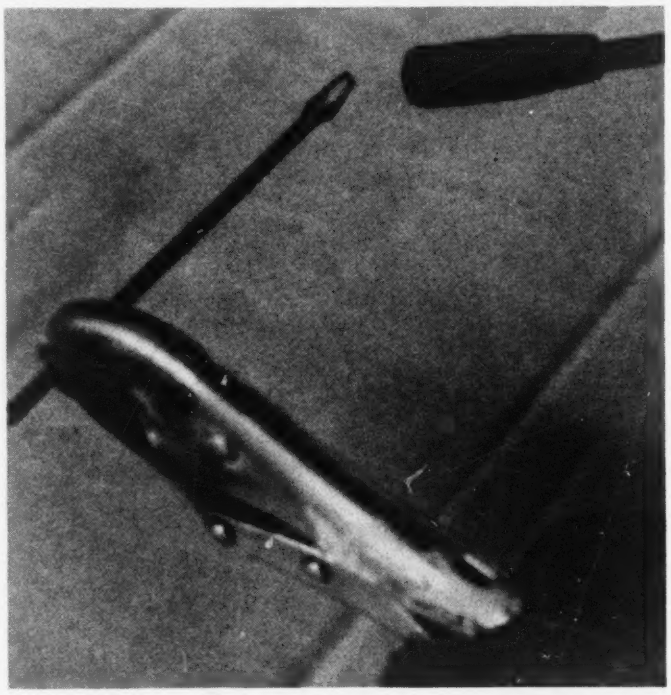


Fig. 57B-1. Heating

Quenching

7. Dip the blade in oil and hold it there about 15 seconds. See Fig. 57B-2. Oil is used because the carbon in it makes the blade tip harder.
8. Withdraw the blade from the oil and allow it to cool to room temperature.
9. Polish your blade using wet or dry sandpaper, then fine emery cloth.

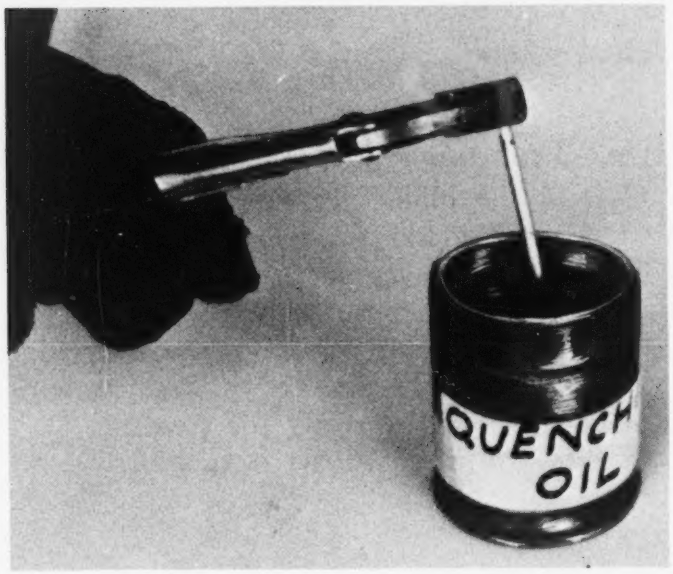


Fig. 57B-2. Quenching

Cleaning Up

10. Store your blade for the next lesson.
11. The last student to use the propane torch is to extinguish the flame.
12. Answer questions in your Laboratory Manual.
13. Clean up the work area and the equipment supervisor will return all equipment.

Questions

1. What conditioning process was this?

   t ______________ -c ______________

2. Why was it necessary to condition the screwdriver blade?

   ____

   ____

3. What material was used to condition the blade?

   o ______________

4. What color should the blade have turned before you conditioned it?

   c ______________ r ______________

ACTIVITY 58

Making Assemblies or Finished Products

Today you will perform several finishing procedures on your screwdriver handle and blade, ending with a finished product.

Problem 1

Objective

Using the proper equipment, perform sawing and filing operations on a screwdriver handle.

Equipment (Class)

1 miter box with saw
3 fine-tooth mill files

Supplies (Group of 5)

3 pcs. medium grit silicon-carbide abrasive paper 2" x 2"

Safety

1. Wear safety goggles in drilling your screwdriver handle.
2. All files should have handles on them.
3. Do not let epoxy resin come in contact with your clothing or skin.
4. Keep room properly ventilated.

Preparing to Work

1. Obtain your screwdriver handle from your teacher.
2. Remove your conditioned handle from the test tube.
3. Fasten a stop block on the left side of the miter box saw so that the screwdriver handle will be cut to a length of 4". See Fig. 58-1.

Fig. 58-1. Cutting Handle

Sawing

4. Saw your screwdriver handle to length.

Filing and Sanding

5. Using a mill file, remove any rough places. File a chamfer around the sawn portion of the handle.
6. Using wet-or-dry abrasive paper, sand the end that was sawn and filed.

Problem 2

Objective

Using the proper equipment and supplies, perform a drilling operation on a screwdriver handle.

Equipment (Class)

1 drill press
1 $\frac{3}{16}$" twist drill bit
1 drilling jig for screwdriver handle
1 3" spring clamp

Supplies (Per student)

1 4" screwdriver handle

Preparing to Work

1. Make sure you have cut your screwdriver handle to a 4" length in the miter box.

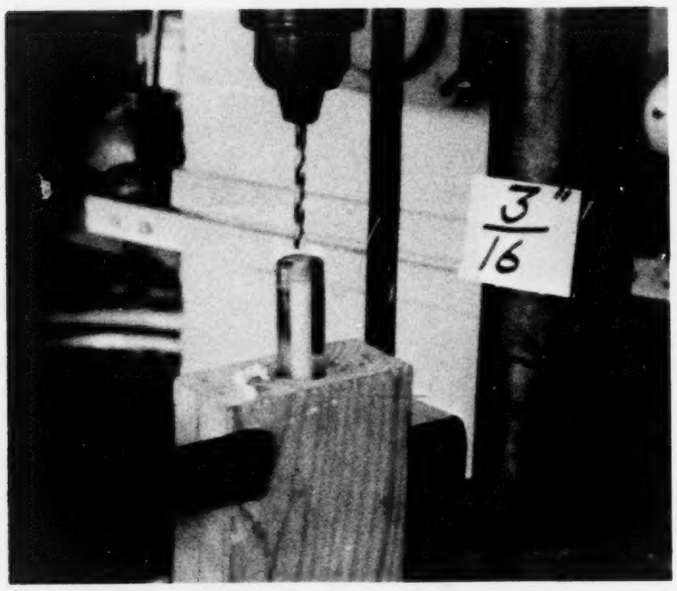


Fig. 58-2. Drilling Handle

Drilling

2. Using the drilling jig and drill press, drill a $\frac{3}{16}$" centered hole, $1\frac{1}{2}$" deep in the sawn end of the screwdriver handle. See Fig. 58-2.
3. Make sure you have clamped your work before you begin drilling.

Problem 3

Objective

Using proper supplies, perform mixing, coating, and adhesion bonding operations to produce an assembled screwdriver.

Equipment (Class)

1	drying rack, from ACTIVITY 57A

Supplies (Group of 5)

1	6" screwdriver blade, ACTIVITY 56B and C/student
1	4" screwdriver handle/student
1 tube	epoxy resin
1 tube	epoxy hardener
5	mixing plates *or* 3" x 5" cards
5	wooden sticks, for mixing

Safety

Recap each resin and hardener tube at once, after use. DO NOT mix up the caps: a hardener cap MUST NOT be put on a resin tube.

Mixing Resin

1. Place one drop of epoxy resin on a 3" x 5" card or mixing plate.
2. Place an equal amount of epoxy resin hardener beside the drop of epoxy resin. See Fig. 58-3.
3. Mix the resin and hardener together till a yellowish color appears.

Coating

4. Apply epoxy to the shank end of the screwdriver blade. See Fig. 58-4.

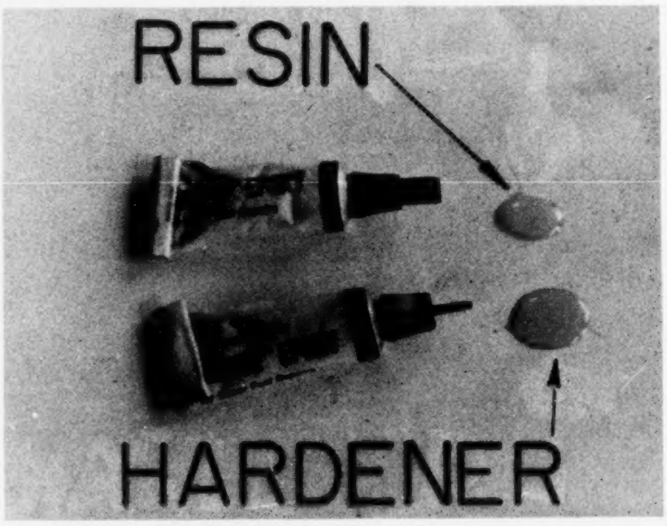


Fig. 58-3. Mixing Resins

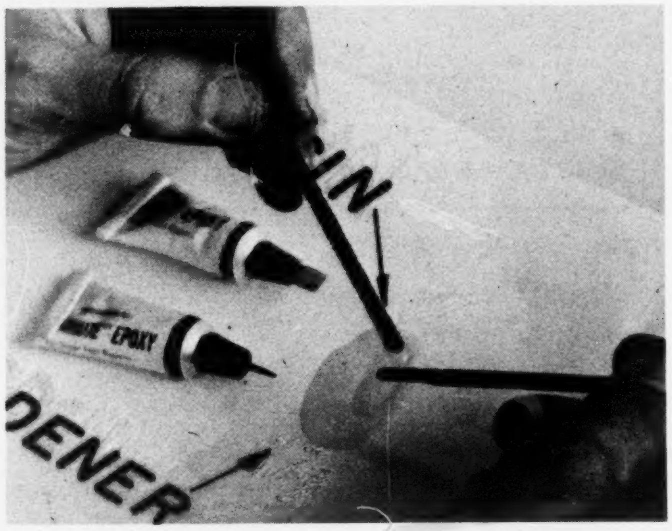


Fig. 58-4. Applying Epoxy

Bonding

5. Press the coated shank into the drilled hole of the plastic handle. See Fig. 58-5. The epoxy will cure in 24 hours. Your screwdriver will look like those in Fig. 58-6.

Cleaning Up

6. Return all supplies and clean your work area.
7. Use masking tape to label your screwdriver and give it to your teacher for storage.
8. Fill in Fig. 58-7, Processing Checklist (Screwdriver).

Fig. 58-5. Assembling Shank and Handle

Fig. 58-6. Finished Screwdriver

Fig. 58-7. Process Checklist (Screwdriver)

Directions: Circle the number of each process you used in manufacturing the screwdriver. Write in the technique that you used in each process checked.

		Process	Part	Techniques
1	**Forming**	Casting or Molding	Handle	
2		Compressing and Stretching	Blade	
3		Conditioning	Handle blade	
4	**Separating**	Chip Removing	Handle blade	
5		Shearing		
6		Other Separating Practices		
7	**Combining**	Mixing	Epoxy glue	
8		Bonding	Handle to blade	
9		Mechanical Fastening		
10		Coating		

ACTIVITY 59

Material Separating Practices

Today's reading described three basic groups or classes of processes for separating solid materials: (1) shearing, (2) chip removing, and (3) separating by other processes. You will make an I.D. tag, using all three practices described in the reading.

Problem 1

Objective

Using the necessary equipment, apply two separating practices to shape the blank for an I.D. tag.

Equipment (Group of 5)

1	12" steel rule
1	hand drill
1	1/8" twist drill
3	10" mill file, single cut
1	ball peen hammer, 8 oz.
1	center punch
1	3/8" countersink
1	scratch awl
1	tin snips

Supplies (Group of 5)

1	20 ga. 1" x 5" anodized aluminum

Preparing to Work

1. Assemble with your group and equipment supervisor to get needed equipment and supplies.

Safety

Wear safety glasses when using tin snips or drilling.

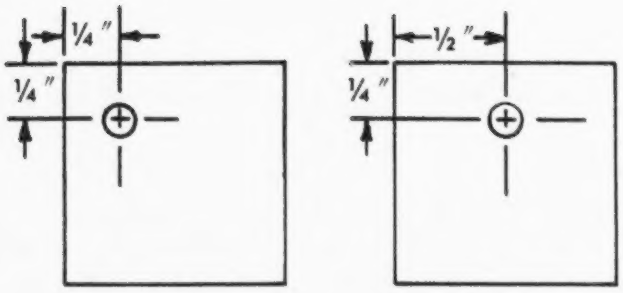


Fig. 59-1. Location of Hole for I.D. Tag

Shearing

2. With a steel rule and scratch awl, the recorder should lay out five 1" pieces from the anodized metal strip.
3. Using tin snips, the timekeeper should cut off 1" pieces as marked.

Chip Removing

4. The foreman can round corners and remove burrs with a file.
5. Use a steel rule and pencil to lay out the location of a 1/8" hole. See Fig. 59-1 for suggested hole location.
6. Center punch location for 1/8" hole.
7. Drill 1/8" hole with hand drill.
8. Use countersink in hand drill to remove burrs from hole.

Problem 2

Objective

Using the necessary equipment and supplies, etch a figure on a metal I.D. tag by chemical separating.

Equipment (Group of 5)

3	X-acto® knives
4 pr.	scissors

Supplies (Group of 5)

5	cotton swab sticks
1 tube	1½ oz. etching cream-Etchall
10 pcs.	1" x 1" contact vinyl

Safety

Safety supervisor check the following:

a. Keep fingers from in front of X-acto® knife when cutting.
b. Keep etching cream off hands, clothes, and out of eyes.

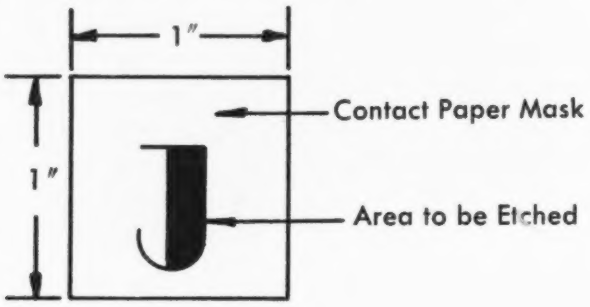


Fig. 59-2. I.D. Tag Design

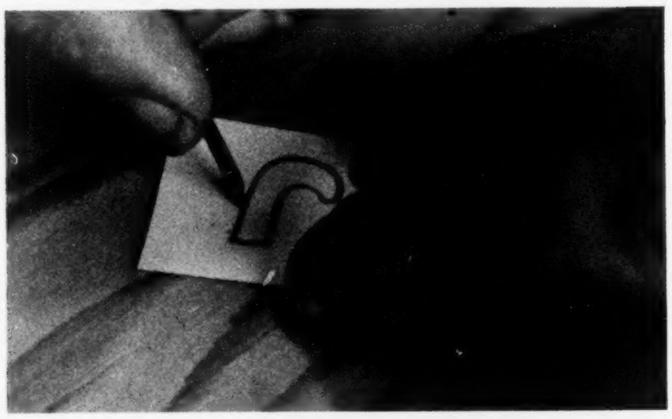


Fig. 59-3. Shearing Vinyl

Masking

1. Draw a single design or your initial on two pieces of 1" x 1" contact vinyl. See Fig. 59-2.
2. Using scissors and/or an X-acto® knife, shear design from vinyl. See Fig. 59-3.
3. Apply contact vinyl mask to *each* side of prepared blank. Make sure that the contact vinyl is firmly adhered to the blank.

Etching

4. Using the cotton swab, apply etching cream to the exposed area of the mask, both sides of blank.
5. Hang blank on rack provided.
6. While part is being etched, clean up the equipment and supplies. Equipment supervisor should return all unused materials to designated spaces. Etching will require about 10 minutes. Answer the Laboratory Manual questions during this time.
7. Wash etching cream off the part with water and dry thoroughly with paper towel.
8. Remove the contact vinyl mask.

Questions

Check the proper blank to show the process used.

	Shearing	Chip Removing	Other Processes
1. Cutting vinyl mask	______	______	______
2. Etching tag	______	______	______
3. Rounding corners	______	______	______
4. Cutting blank to size	______	______	______
5. Drilling hole	______	______	______

ACTIVITY 60A

Shearing

Today you will use a die cutter to shear a vinyl sticker.

Problem

Objective

Using a die cutter and the necessary equipment and supplies, shear a vinyl sticker.

Equipment (Class)
2 or 3 die cutter jigs No. 109
2 or 3 rubber mallets, 16 oz.

Supplies (Group of 5)
5 pcs. contact vinyl 7" x 9", any color, solid

Preparing to Work

1. Assemble with your group and obtain your supplies. It will be necessary for your group to alternate using the die cutter. When your teacher indicates that it is your group's turn to do this problem, obtain the equipment.
2. Obtain your piece of vinyl and fold it to a size of 7" x 4½". This will enable you to shear two components at the same time.

Die Cutting

3. Place the piece of vinyl over the blade of the die cutter. Make sure the vinyl covers the entire area of the die cutter. Closing the two-piece die as you would a book, carefully cover the vinyl with the top hinged section. See Fig. 60A-1.
4. Using the rubber mallet, firmly hammer ONE TIME on the top of the die cutter at the spot indicated in Fig. 60A-2.
5. Carefully lift the cover and check to see if the entire component has been sheared. If it has not, apply additional pressure where necessary. See Fig. 60A-3.
6. Remove your components from the die cutter. Pass the die cutter and the rubber mallet promptly to the next group so they may complete the shearing operation.
7. Print your name on the component and store as directed by your teacher.
8. Return tools and equipment to proper storage area.

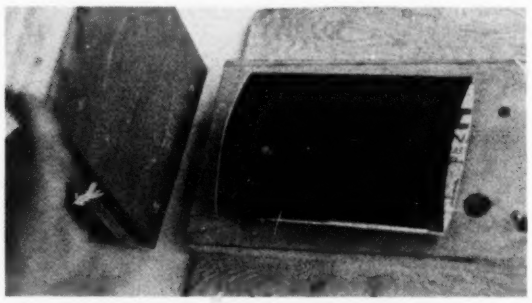


Fig. 60A-1. Placing Vinyl in Die

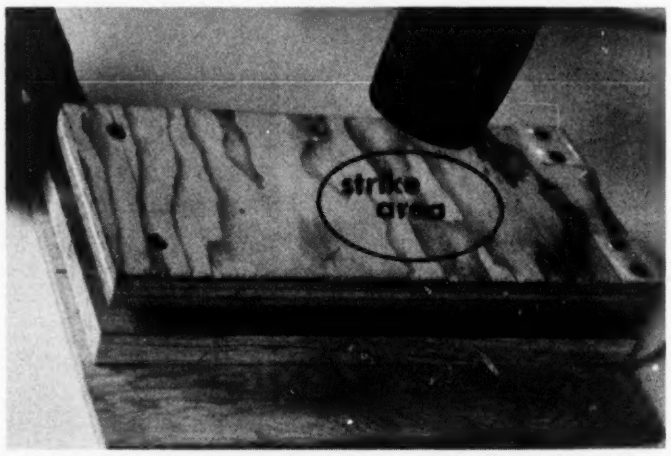


Fig. 60A-2. Striking Die

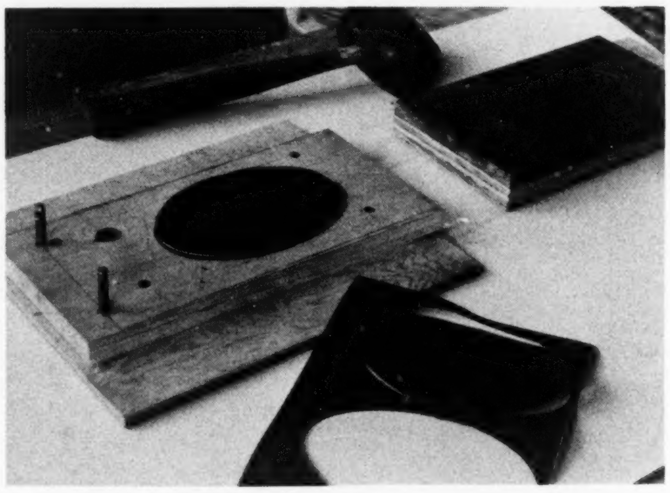


Fig. 60A-3. Finished Die Cut

ACTIVITY 60B

Shearing

Today you will develop a design and cut out the design to produce a stencil for coating the sticker.

Problem

Objective

Using proper equipment and supplies, create a design and shear a stencil.

Equipment (Group of 5)

5 X-acto® knives *or* single-edge razor blades

Supplies (Group of 5)

5 pcs.	printed-pattern sheet
1 roll	masking tape
5 pcs.	waxed paper 6″ x 8″

Preparing to Work

1. Assemble with your group and obtain your supplies and equipment.

Designing

2. On a printed-pattern sheet, design an emblem or symbol to fit within the space. See Fig. 60B-1. You may wish to create more than one design on scrap paper and then select the best one for your pattern sheet.

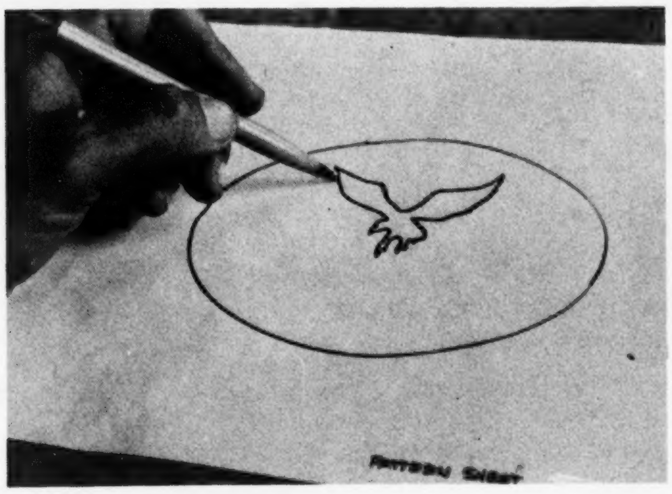


Fig. 60B-1. Designing Emblem

Shearing

3. Using masking tape, fasten the waxed paper over the design which you have sketched on your pattern sheet. See Fig. 60B-2.

Safety

The safety supervisor should see that students work carefully with X-acto® knives or razor blades.

4. Using the knife or razor blade, shear the design from the waxed paper. Make certain there are no ragged edges. See Fig. 60B-3.

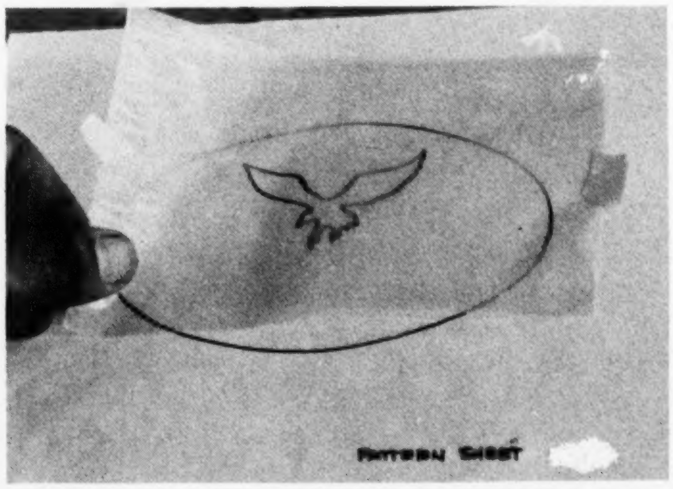


Fig. 60B-2. Wax Paper Overlay

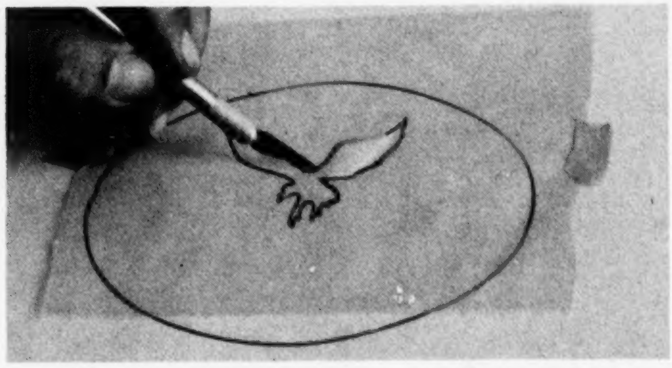


Fig. 60B-3. Shearing Design

5. Separate the waxed paper stencil from the pattern sheet. Be careful not to wrinkle the stencil. See Fig. 60B-4.
6. Label the stencil with your name and store it for use in the next activity.
7. Clean up your work area. The equipment supervisor will return all supplies and equipment.

Fig. 60B-4. Separating Stencil from Pattern

ACTIVITY 61

Combining Components

Today you will coat the sticker by screen-stenciling and spray-stenciling.

Problem 1

Objective

Using a prepared screen stencil and the necessary equipment and supplies, coat a component by screen-stencil printing.

Equipment (Class)

3	prepared screen stencils
3	squeegees

Supplies (Class)

3 qt. screen-stencil paint, any color

Preparing to Work

1. Assemble with your group. The teacher will indicate when it is your turn to use the screen-stencil apparatus.

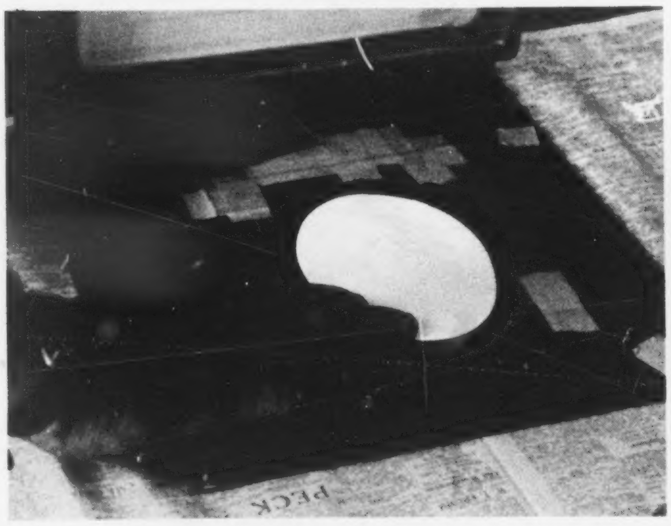


Fig. 61-1. Registering Sticker

Printing

2. Raise the screen. Place one sticker in the registered position. See Fig. 61-1. Lower the screen in place.

3. Pull the squeegee across the screen one time. Press down firmly as you pull. See Fig. 61-2.

4. Raise the screen, remove the printed sticker and place in a safe place to dry. Drying will require a few minutes. See Fig. 61-3.

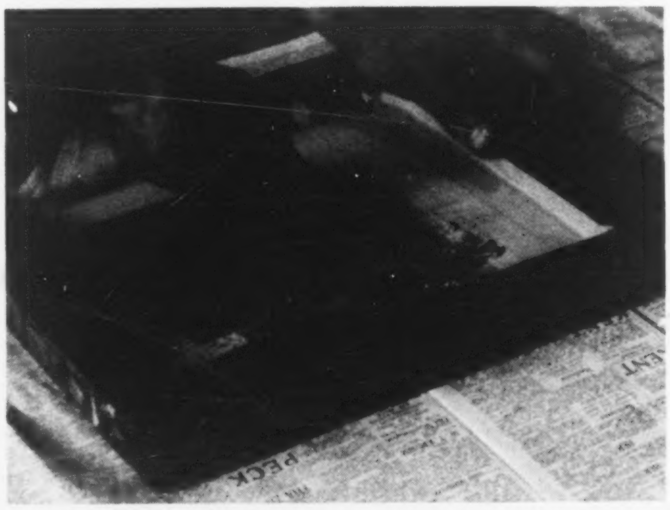


Fig. 61-2. Pulling Squeegee

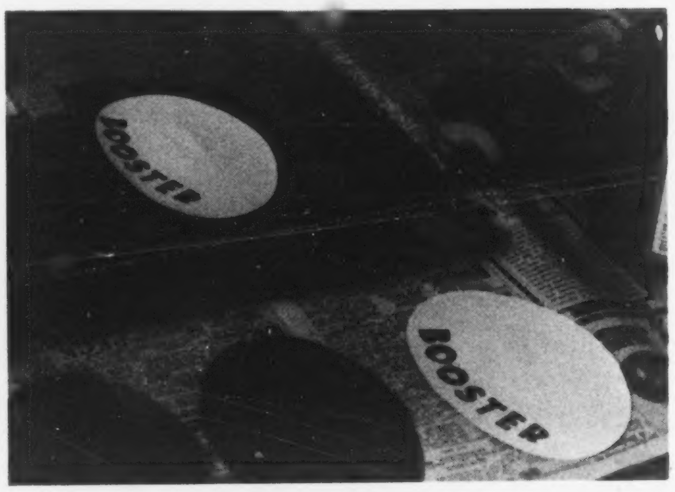


Fig. 61-3. Printed Stickers

Problem 2

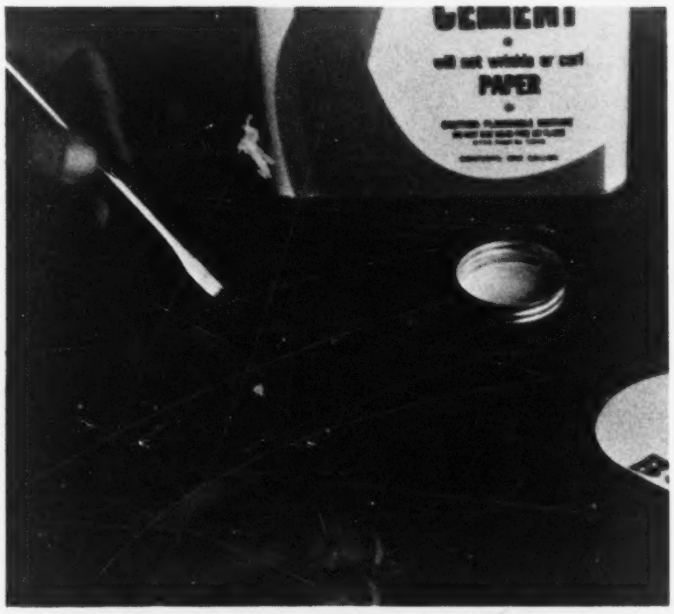


Fig. 61-4. Applying Cement

Objective

Using a paper stencil and the necessary equipment and supplies, coat a component by spray-stenciling.

Supplies (Group of 5)

5	sticker components, from ACTIVITY 60A
5	stencils, from ACTIVITY 60B
1 can	quick dry spray paint, any color
1 btl.	rubber cement with applicator cap

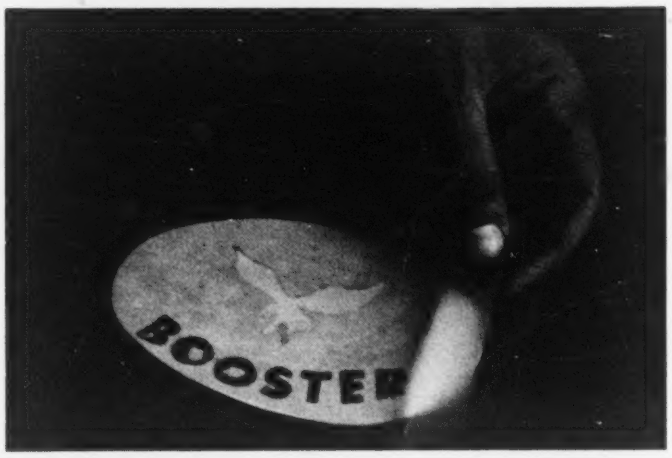


Fig. 61-5. Adhering Stencil to Sticker

Applying the Stencil

1. Apply a thin coat of rubber cement to the back of the waxed-paper stencil. Be careful not to wrinkle the stencil. See Fig. 60-4.
2. Adhere the stencil to the vinyl sticker in the proper position. See Fig. 60-5. Make certain that no rubber cement is left in the opening.

Spray-Coating

3. Place newspaper on the bench top and place the stencil and sticker on the newspaper.
4. Using the can of spray paint, coat the sticker. See Fig. 61-6. Allow the paint to dry completely before removing the stencil.
5. After the paint has dried, carefully remove the stencil. See Fig. 61-7.
6. Adhere the stencil to another vinyl sticker and repeat the coating process.
7. When you have completed coating your stickers, the equipment supervisor should return all equipment and supplies while you clean up your work area.
8. Complete Fig. 61-8, Process Checklist (Sticker).

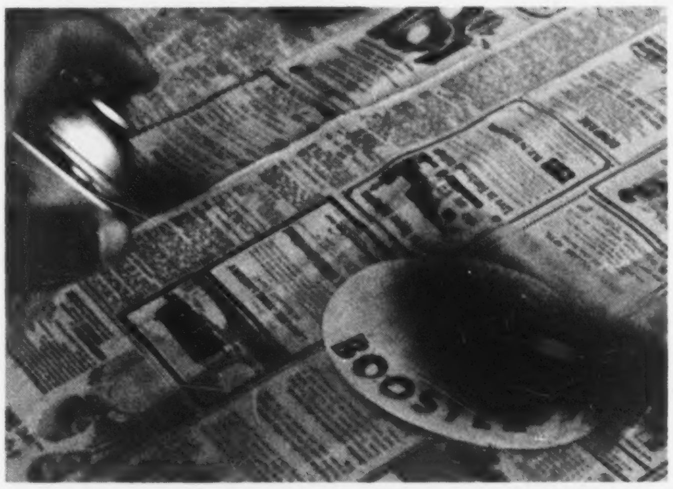


Fig. 61-6. Spraying Sticker Stencil

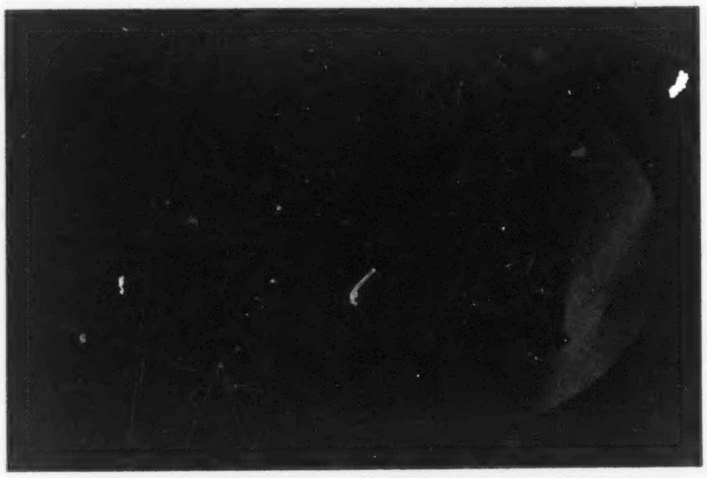


Fig. 61-7. Finished Sticker

Fig. 61-8. Process Checklist (Sticker)
Directions: Circle the number of each process you used in manufacturing the sticker. Identify the technique that you used in each process checked.

		Process	Part	Techniques
1	**Forming**	Casting or Molding		
2		Compressing and Stretching		
3		Conditioning		
4	**Separating**	Chip Removing		
5		Shearing	Sticker stencil	
6		Other Separating Practices		
7	**Combining**	Mixing		
8		Bonding	Sticker to stencil	
9		Mechanical Fastening		
10		Coating	Stencil	

ACTIVITY 62A and B

Chip Removing

There are two problems to be completed during these two laboratory periods. Your teacher will tell your group which problem to do first, and direct you to a work station. After you complete each problem, check the work with your teacher. He will approve it and direct you to your next assignment.

Problem 1

Objective

Using proper equipment and supplies, perform sawing, sanding, drilling, and filing operations to produce house-marker components.

Equipment (Group of 5)

1	power sander, if available
1	bandsaw *or* jigsaw, if available
1	1/16″ twist drill
1	¼″ twist drill
1	⅛″ twist drill
1	countersink
1	brace
1	hand drill *or* drill press
1	crosscut saw
4	coping saws
3 pr.	scissors
1	12″ rule
1	scratch awl
1	wood file

Supplies (Group of 5)

5 pcs. ¾″ x 3½″ x 12″ wood
1 sht. medium-grit abrasive paper

Preparing to Work

1. Meet with your group and get your equipment and supplies. You will work individually on this problem, but you are to share equipment.
2. Turn to the house-marker designs shown in Fig. 62A-1. Component A, which you will be manufacturing today, will look like either design #1, 2, 3, or 4.
3. Select the design you like best. Cut out the half-pattern for your design with a pair of scissors.
4. You will use a piece of ¾″ x 3½″ x 12″ wood. If you need to cut this stock to length, use the crosscut saw. See Fig. 62A-2.

Laying Out the Pattern

5. Lay the *center line* of the half-pattern on the *center* of the piece of wood and trace around it. See Fig. 62A-3.

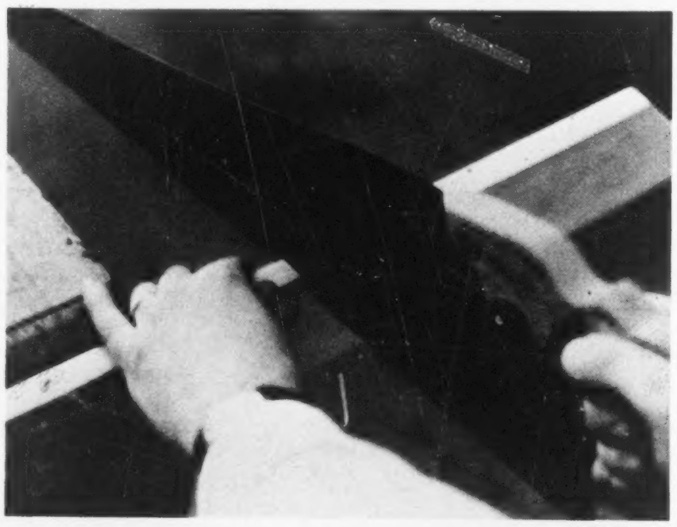


Fig. 62A-2. Cutting Wood to Length

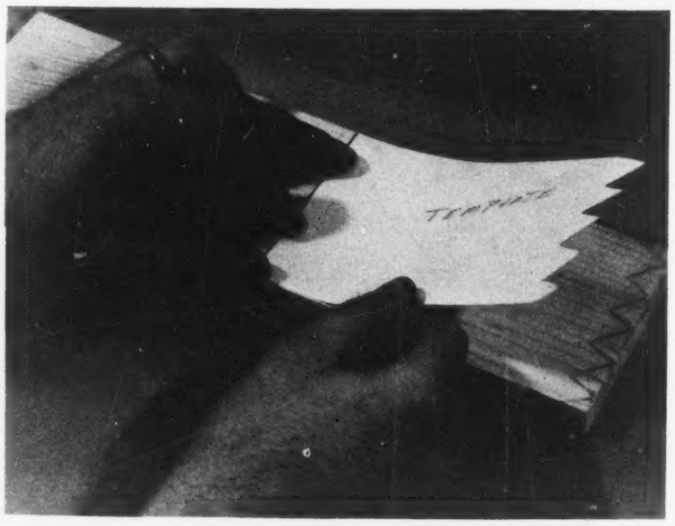
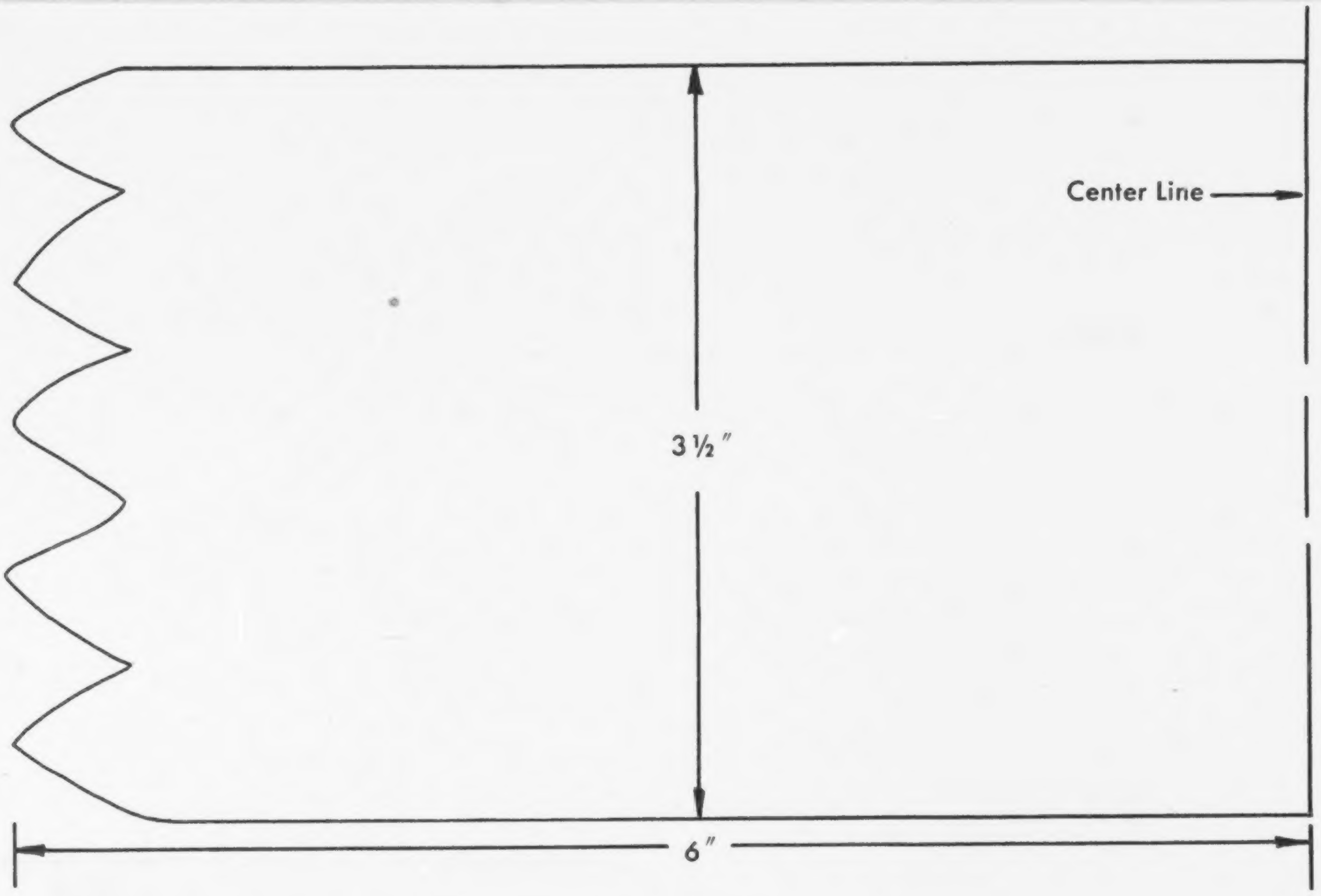


Fig. 62A-3. Placing Pattern on Wood


Center Line
3 ½″
6″

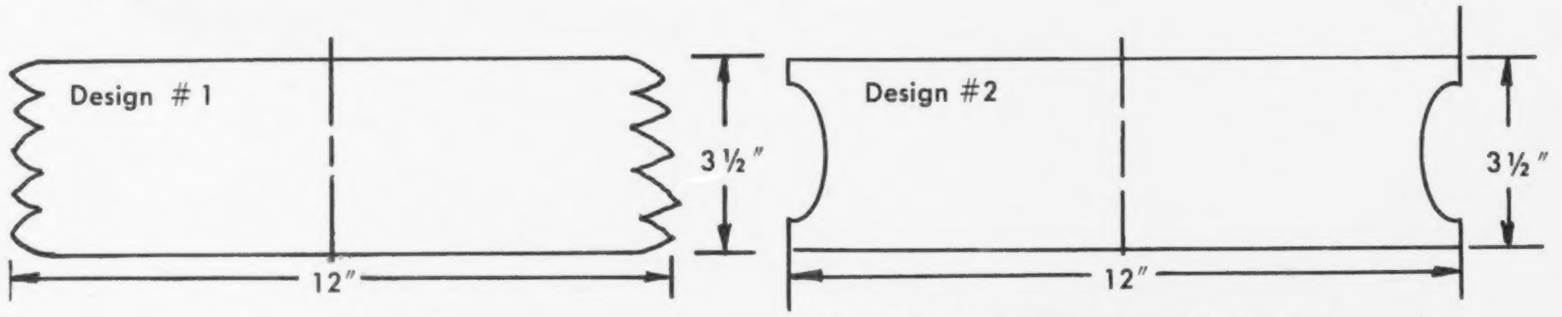
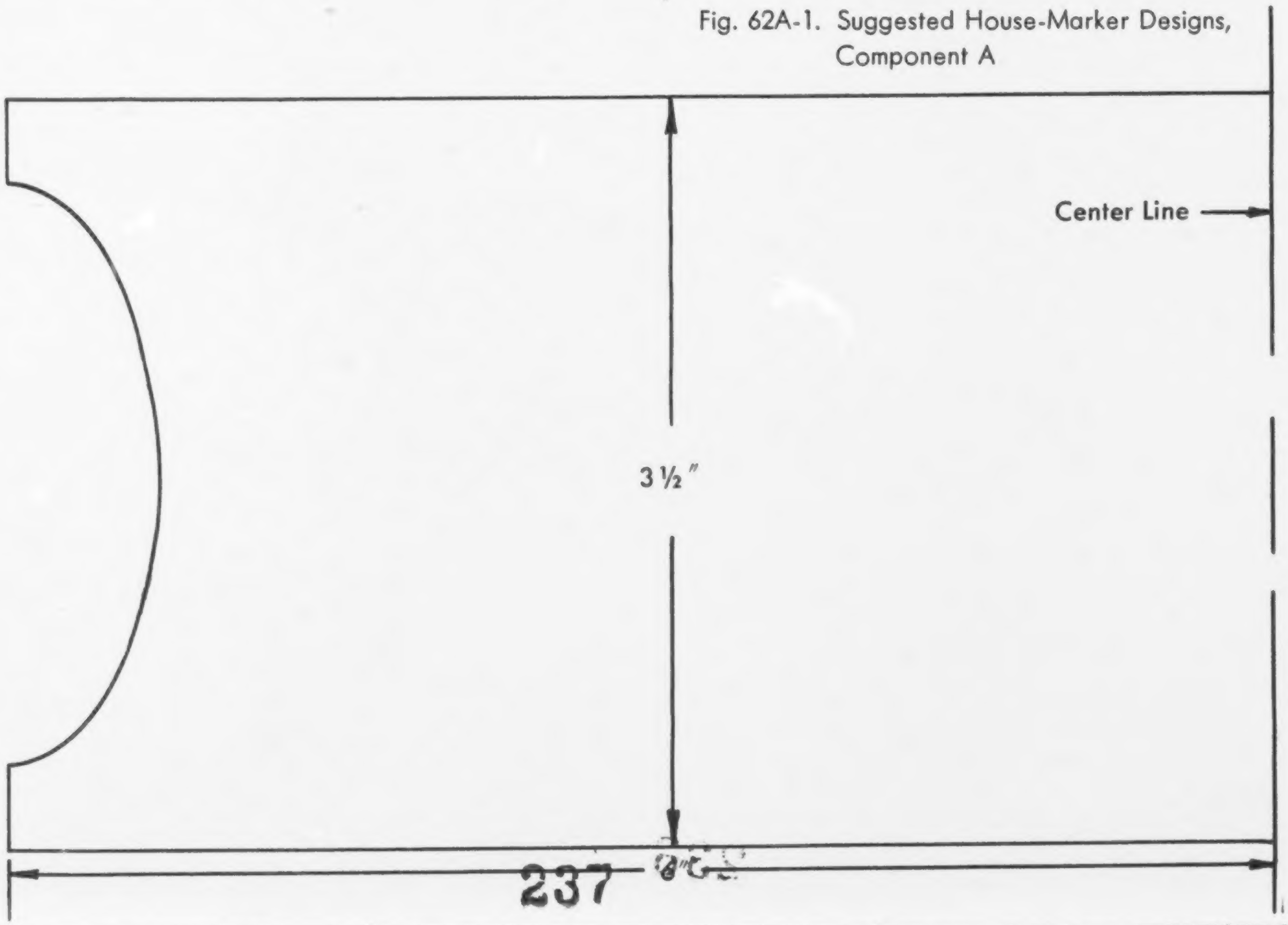

Design # 1
3 ½″
12″
Design #2
3 ½″
12″

Fig. 62A-1. Suggested House-Marker Designs, Component A


Center Line
3 ½″
6″

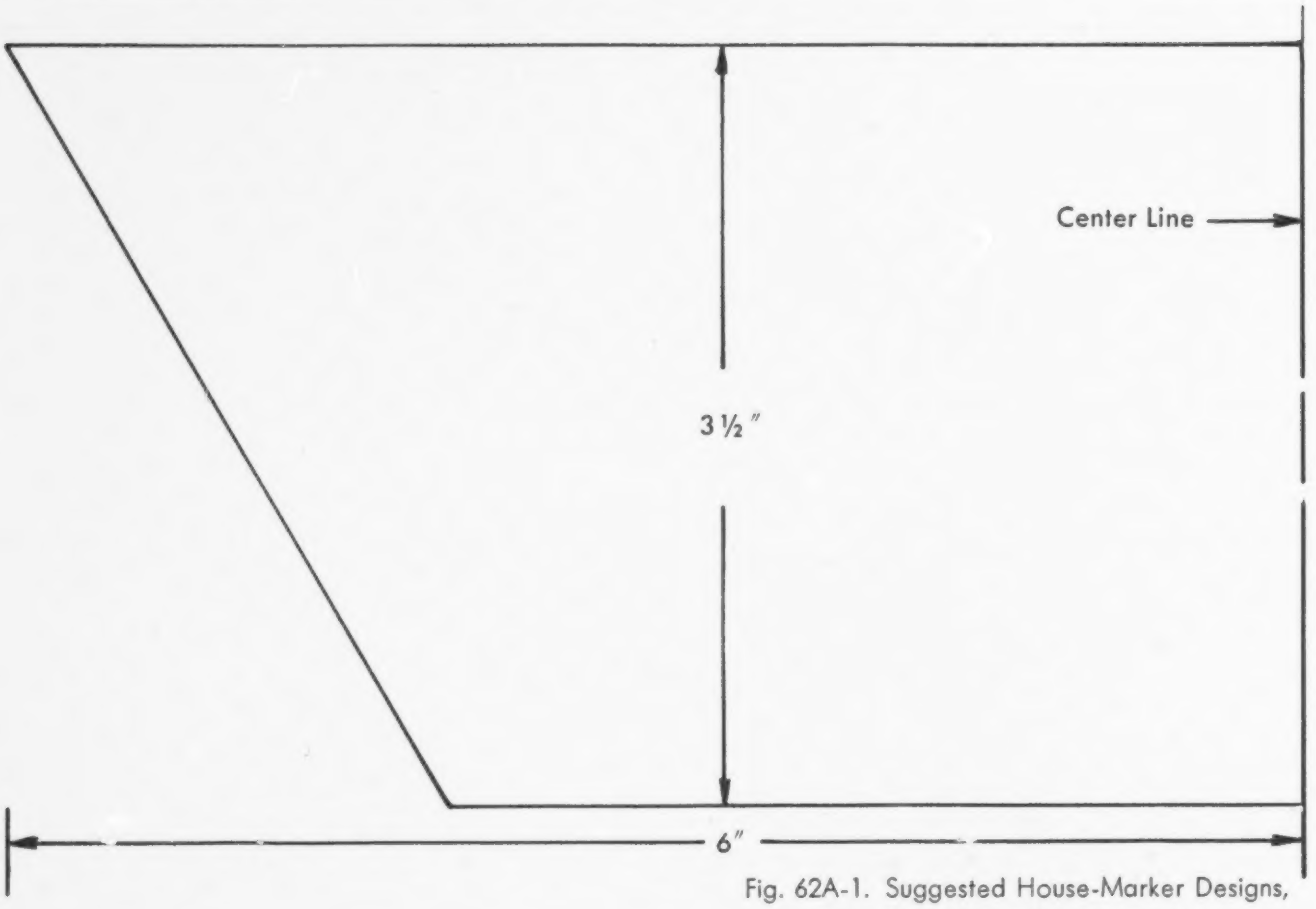
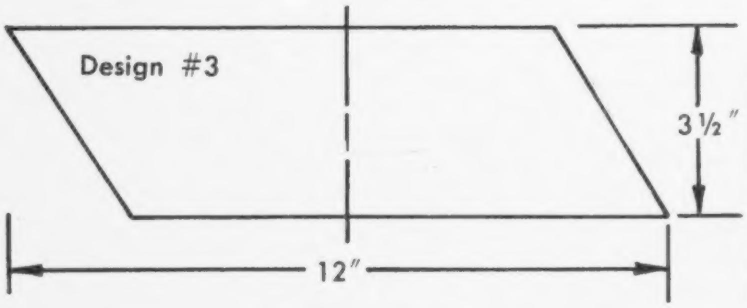
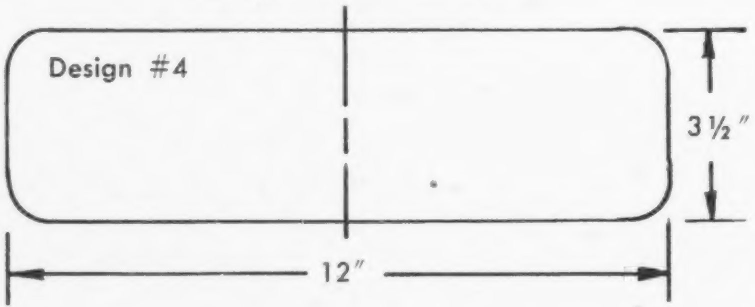
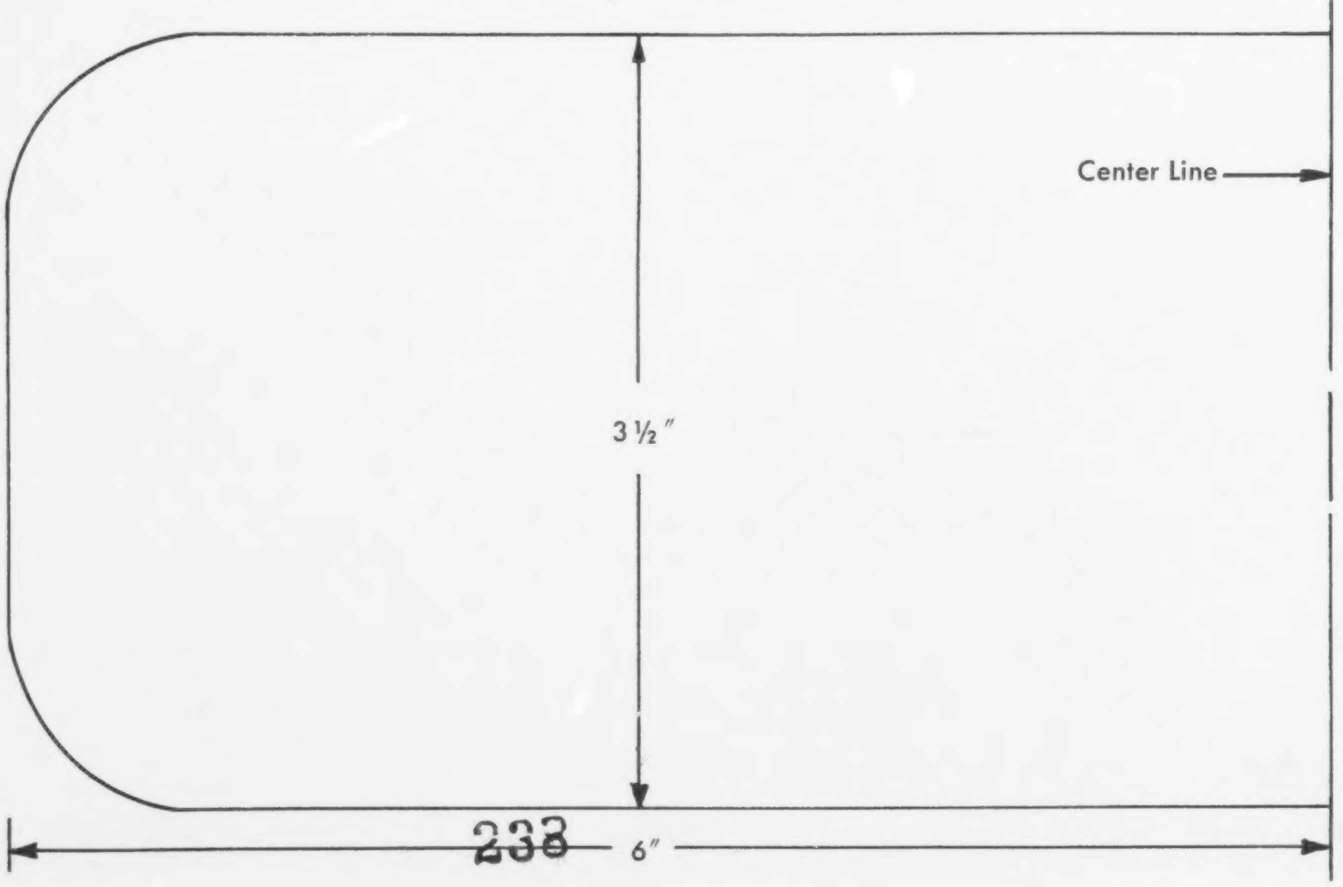

Center Line
3 ½″
6″

Fig. 62A-1. Suggested House-Marker Designs, Component A (continued)


Design #3
3 ½″
12″


Design #4
3 ½″
12″


Center Line
3 ½″
6″

6. Reverse the pattern and trace around the other side. See Fig. 62A-4.
7. Lay out the locations of holes to be drilled. If you choose to use screw eyes as a way of hanging the marker, or if your choice is to mount it on a wall, see Fig. 62A-5. If your choice is the center-rod lawn marker, see Fig. 62A-6.
8. After locating holes, mark them with a scratch awl. See Fig. 62A-7, which illustrates holes being marked for screw eyes.

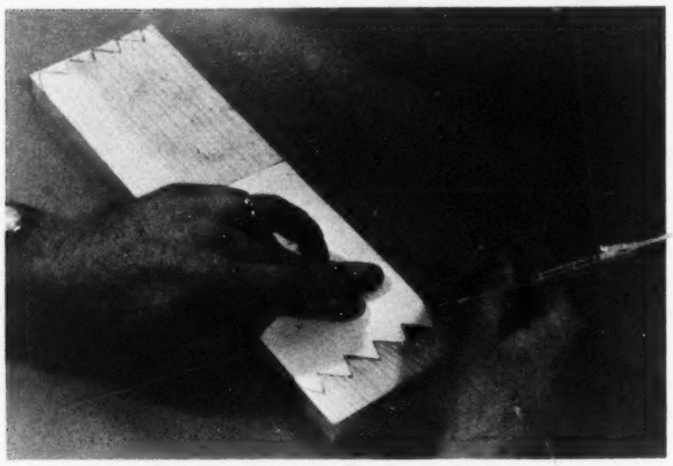


Fig. 62A-4. Completing Pattern Tracing

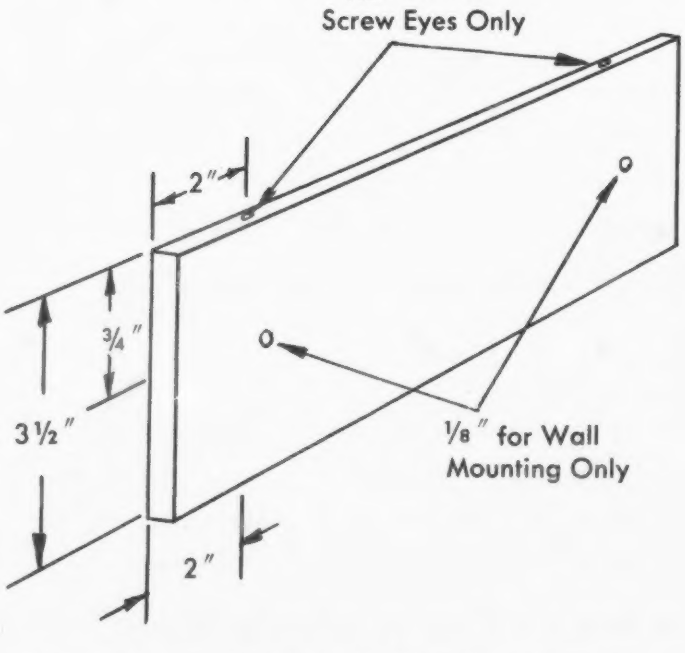


Fig. 62A-5. Locating Holes for Mounting House Marker with Screw Eyes or on the Wall

Drilling

9. Drill 1/16″ pilot holes for the screw eyes 1/4″ deep, using the drill press or hand drill. For the center-rod lawn marker, drill a 1/4″ hole, 1″ deep. For the direct wall-mounted marker, drill through the face of the marker, using a 3/16″ drill. Countersink to a depth of 1/8″ to fit the screw head. See Fig. 62A-8.

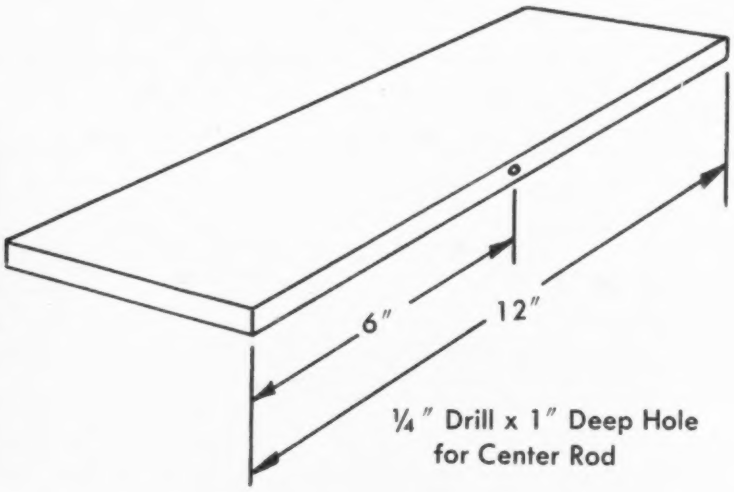


Fig. 62A-6. Locating Hole for Center Rod

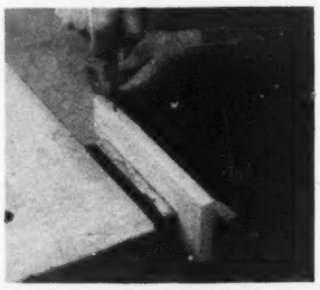


Fig. 62A-7. Marking Hole Location with Scratch Awl

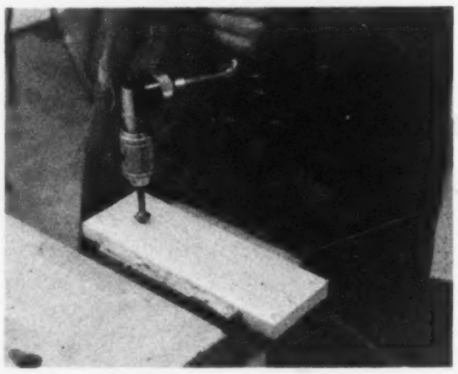


Fig. 62A-8. Countersinking Holes for Wall Mounting

Sawing and Finishing

10. Saw out the design, using a coping saw *or* jigsaw *or* bandsaw. See Fig. 62A-9.
11. File and sand all *edges*. Sand the *faces* with abrasive paper, using a block of wood as a backing. See Fig. 62A-10.
12. Have your teacher check your workpiece.

Labeling

13. On a piece of masking tape, print your name and the component number (62A-1) and attach the tape to the component. See Fig. 62A-11. Give this to your teacher to store for the next activity.

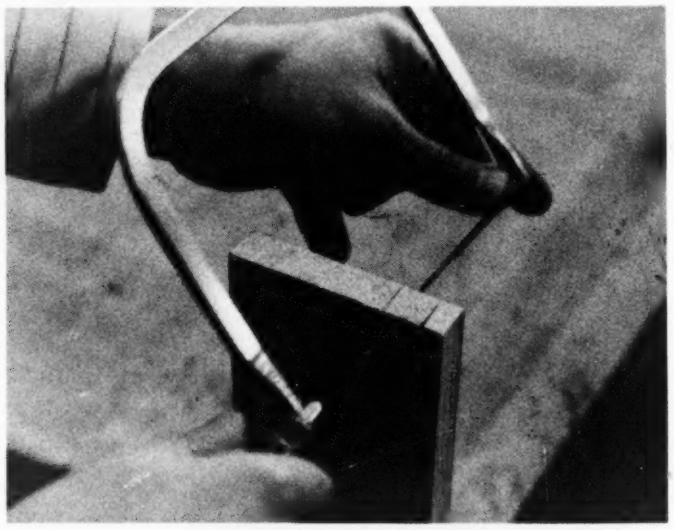


Fig. 62A-9. Sawing Out House-Marker Design

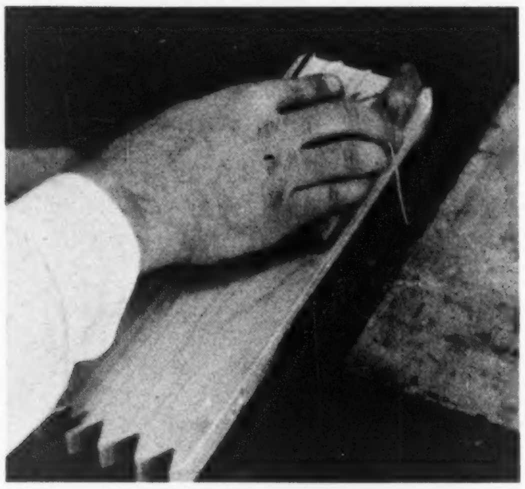


Fig. 62A-10. Sanding House Marker

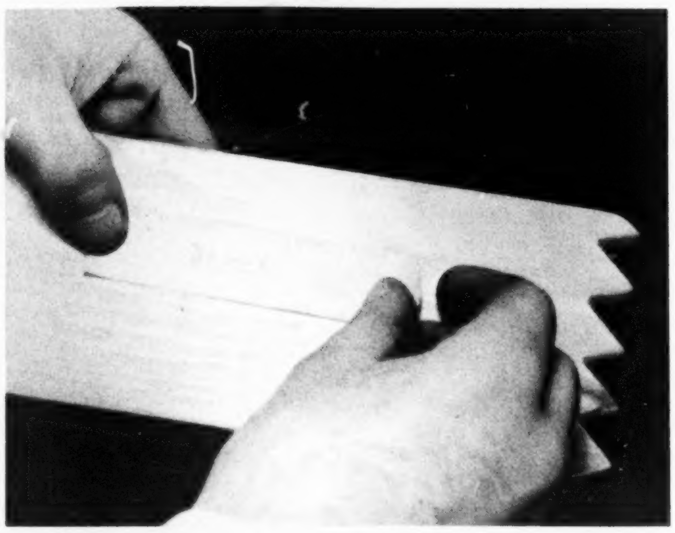


Fig. 62A-11. Taping Name to House Marker

Problem 2

Objective

Using proper equipment and supplies, perform shearing operations to produce a contact vinyl house-number stencil.

Equipment (Group of 5)

5	12″ rulers
5	felt marking pens, fine point
5	X-acto® knives
5 pcs.	⅛″ x 12″ x 12″ hardboard
1 set	2½″ Gothic-numeral stencils

Supplies (Group of 5)

5 pcs.	4″ x 12″ dark contact vinyl

Safety

a. Wear goggles when using power equipment.
b. Never saw or drill toward any part of the body.

Preparing to Work

1. Assemble with your group and obtain the necessary equipment and supplies.

Tracing Numerals onto the Stencil

2. Draw a guideline on the stencil, ½″ from the top. Use the ruler and felt-tip pen.

Make sure that the hardboard backing is in place. See Fig. 62B-1.

3. Center the numerals you have selected on the stencil. The top of each numeral should just touch the guideline. See Fig. 62B-2.
4. Trace around each numeral with the felt-tip pen. See Fig. 62B-3.

Cutting Stencil

5. After tracing all numerals, the stencil can be cut using an X-acto® knife. See Fig. 62B-4. All cutting should be done on the hardboard.
6. Figure 62B-5 shows the completed stencil. Write your name on your completed stencil and then it can be stored.
7. Clean your work area and replace all tools.

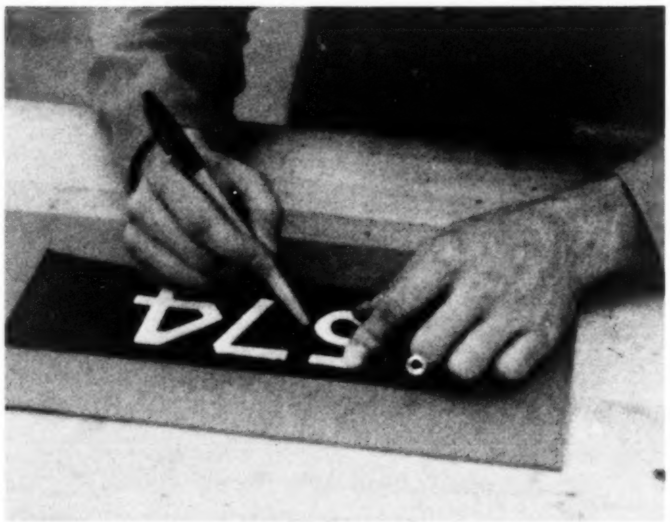


Fig. 62B-3. Tracing Numerals on Stencil

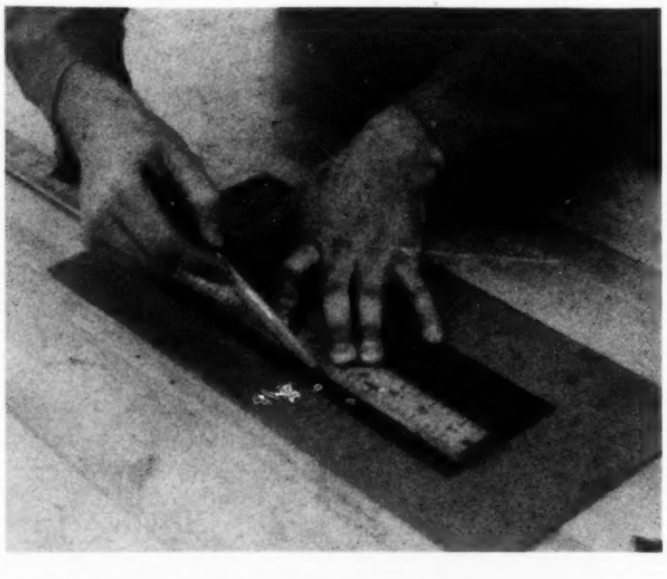


Fig. 62B-1. Drawing Guideline on Stencil

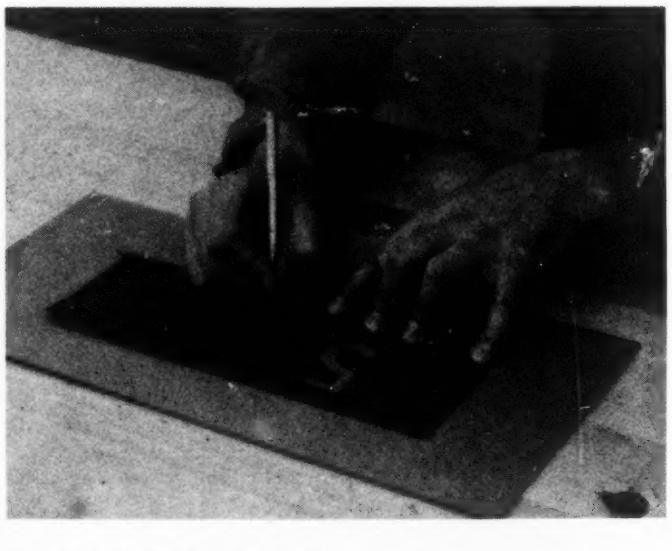


Fig. 62B-4. Cutting Stencil

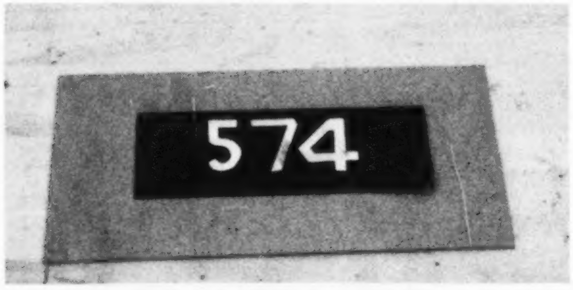


Fig. 62B-2. Centering Numerals on Stencil

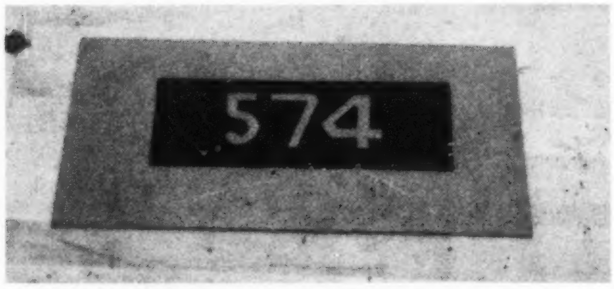


Fig. 62B-5. Completed Stencil

Questions

1. List four chip-removing operations performed in Problems 1 or 2.

Operation	**Tool Class**
__________	__________
__________	__________
__________	__________
__________	__________

2. Beside each operation you listed, state whether it was performed with a cutting tool of the single-edge or multiple-edge class.
3. Why must the pattern not be moved during the tracing operation?

    ____

4. Shearing is less wa__________ than chip-removing processes.
5. Shearing is basically an operation that cuts off or shapes something by means of a me__________ advantage.
6. The material to be sheared is always softer or weaker than the t__________ used.
7. An employee who operates a shearing press usually is considered a se__________ worker.
8. The line along which a piece of material is separated into two components is called a p______l______.
9. The major advantage of chip-removing operations over other ways of separating materials is that they usually can be performed without expensive t__________ or d__________.
10. Chip-removing operations can be grouped in one of two classes, based on the tooling. The classes are s______-e______ cutting and m______-e______ cutting.
11. List the major chip-removing operations performed during Laboratory ACTIVITIES 62A and B.
    a. ______________________________
    b. ______________________________
    c. ______________________________
    d. ______________________________
12. Which of the above operations removed the greatest amount of material in a given period of time?

    ____

13. Which of the above operations produced the smoothest finish on a workpiece?

    ____

ACTIVITY 63

Combining Components

Today you will bond a contact-vinyl stencil to your house-marker panel and use aerosol-spray painting to complete the product.

Problem

Objective

Using the manufactured components 62A and 62B that require bonding and coating, bond the components to produce the finished house-marker product.

Equipment (Class)

1	cardboard box for spray booth, approx. 10″ x 15″ x 20″

Supplies (Group of 5)

5	house-marker panels, component 62A
5	contact-vinyl stencils, component 62B
2 cans	aerosol-spray enamel, any colors

Preparing to Work

1. Meet with your group and get your supplies.
2. Get the contact-vinyl stencil and the wood panel you will need for your house marker.

Spraying

3. Take your house-marker panel to the spray paint area. Spray the surface, top edge, and ends with the spray enamel. See Fig. 63-1.
4. Allow drying time. Then spray the back and bottom edge of the marker to complete the coating.
5. Remove the wax-paper backing from the vinyl stencil and adhere the stencil to the wood panel. See Fig. 63-2.

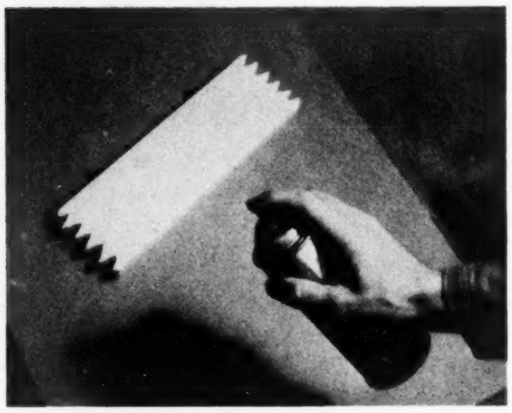


Fig. 63-1. Spray-Painting House Marker

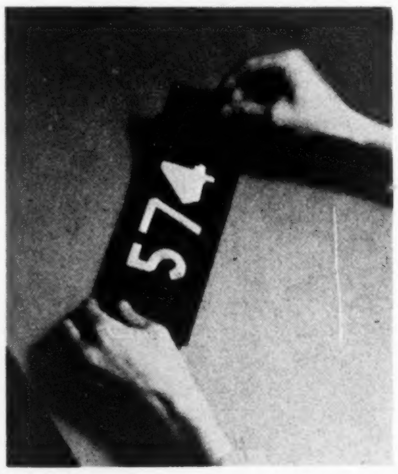


Fig. 63-2. Adhering Stencil to House Marker

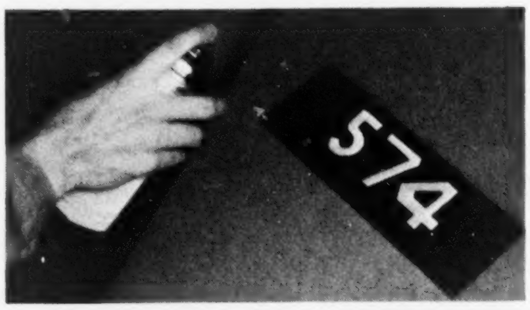


Fig. 63-3. Spray-Painting over Vinyl Stencil

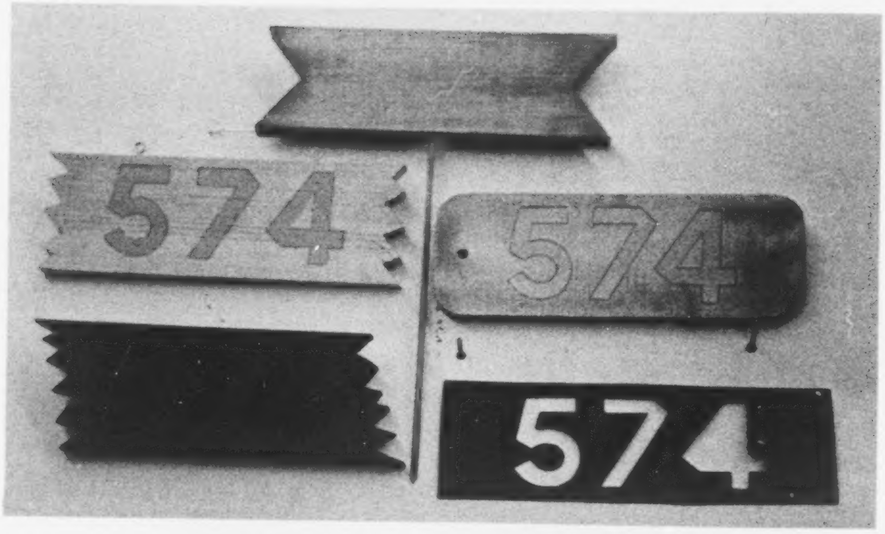


Fig. 63-4. Completed House Markers

6. Spray over the vinyl stencil to obtain the desired house numbers. Allow drying time. See Fig. 63-3.

7. Remove the vinyl stencil carefully. See Fig. 63-4 for completed house marker.

Cleaning Up

8. Clean up the work area and the equipment supervisor will return all equipment and supplies.
9. Complete Fig. 63-5, Process Checklist (House Marker).

Fig. 63-5. Process Checklist (House Marker)

Circle the number of each process you used in manufacturing the house marker. Identify the technique that you used in each process checked.

		Process	Part	Techniques
Example 1	**Forming**	Casting or Molding		
2		Compressing and Stretching		
3		Conditioning		
4	**Separating**	Chip Removing	Wood base	
5		Shearing	Stencil numbers	
6		Other Separating Processes		
7	**Combining**	Mixing	Epoxy	
8		Bonding	Post to wood	
9		Mechanical Fastening	Screw eyes to wood	
10		Coating	Numbers	

ACTIVITY 64A

Separating by Other Processes

Today's lesson concerns separating by nontraditional processes in four categories: *thermal erosion, chemical separating, electrochemical separating,* and *induced-fracture separating.* You are to answer questions about one process and classify several processes in one of the four categories.

Problem

Objective

Using an illustrated presentation on "Separating by Other Processes," and a demonstration of electrical discharge machining:

a. Answer questions about electrical discharge machining.
b. Classify ten processes as thermal erosion, chemical separating, electrochemical separating, or induced-fracture separating.

Questions

1. The electrical discharge machining process required d__________ current.
2. An electrical s__________ performs the actual cutting of the metal workpiece.
3. A liquid that __________ (can/cannot) conduct electricity is used to wash away the chips of excess materials.
4. In the demonstration, the material used to wash away the chips of excess material was called a

   d__________ .

5. These initials are a convenient, brief way to show four classes of processes:

   T.E. — thermal erosion
   C.S. — chemical separating
   E.C.S. — electrochemical separating
   I.F.S. — induced-fracture separating

Identify each of the following as belonging to one of the four classes. Show your answers with initials.

a. __________ electrochemical machining
b. __________ plasma-arc machining
c. __________ laser separating
d. __________ electrical discharge machining
e. __________ printing-plate etching
f. __________ glass cutting
g. __________ electrochemical grinding
h. __________ printed-circuit etching
i. __________ diamond splitting
j. __________ oxygen-acetylene cutting

ACTIVITY 64B

Separating by Other Processes

Today you will separate materials by chemical separating. You will work individually in this activity, but you will share equipment and supplies within your group of five. You will also see a demonstration on induced-fracture separating.

Problem

Objective

Using the appropriate equipment and supplies, cut and etch glass.

Equipment (Group of 5)

1 pr.	gloves
1	oil can
1	glass cutter
4	sanding blocks
3	X-acto® knives
4 pr.	scissors
1	glass cutting jig No. 116-1

Supplies (Group of 5)

3 shts.	3″ x 12″ plate glass, single-thickness
1 sht.	silicon carbide abrasive paper, medium-grit
5 tubes	1½ oz. size glass-etching cream
5 pcs.	3″ x 3″ contact vinyl paper

Preparing to Work

1. Assemble with your regular group and obtain your equipment and supplies.

Safety

The safety supervisors will enforce the following:

a. Use caution when working with glass. Avoid "taking an unnecessary chance."

b. Dispose of scrap glass in a specially provided trash container.

c. All students must wear safety glasses and gloves when separating glass.

2. Place the 3″ x 12″ piece of glass in the glass cutting Jig No. 116-1. See Fig. 64B-1.
3. Apply a few drops of oil to the cutting wheel on the glass cutter. See Fig. 64B-2.

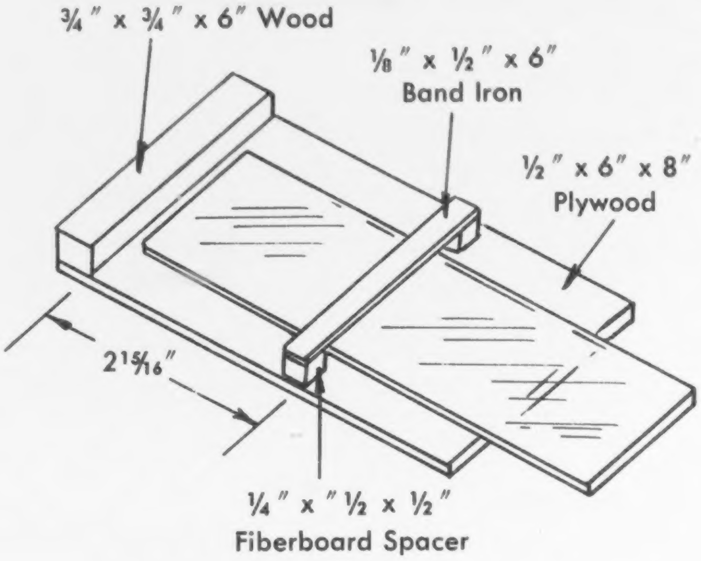


Fig. 64B-1. Glass Placed in a Cutting Jig

Fig. 64B-2. Applying Oil to Cutting Wheel

4. Position the glass cutter on the glass as illustrated in Fig. 64B-3. Notice the angle at which the cutter is held.
5. Press firmly, and with a smooth, uniform stroke draw the glass cutter towards you. Make the score in one stroke.
6. Make sure that the fracture extends across the entire surface of the glass. See Fig. 64B-4.
7. Using the edge of a wooden table or bench, break the glass along the induced fracture. *Safety glasses and gloves should be worn during this operation.* Remove glass from jig. See Fig. 64B-5.

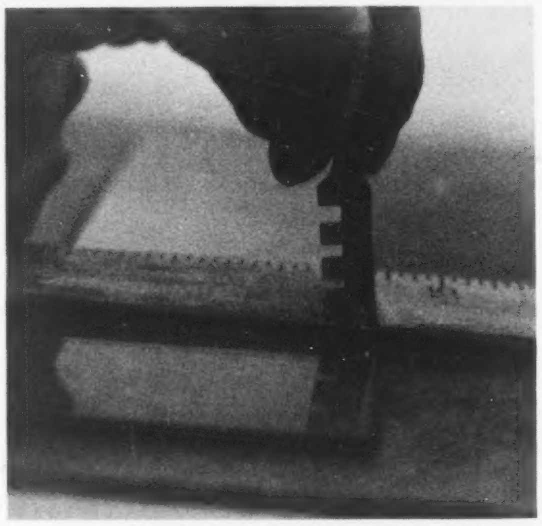


Fig. 64B-3. Positioning Glass Cutter

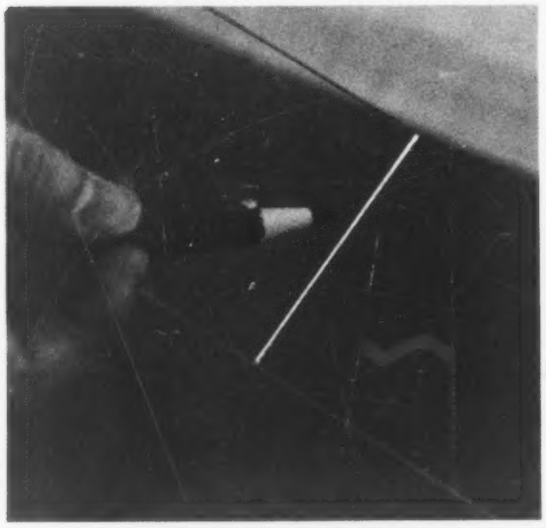


Fig. 64B-4. Completed Fracture

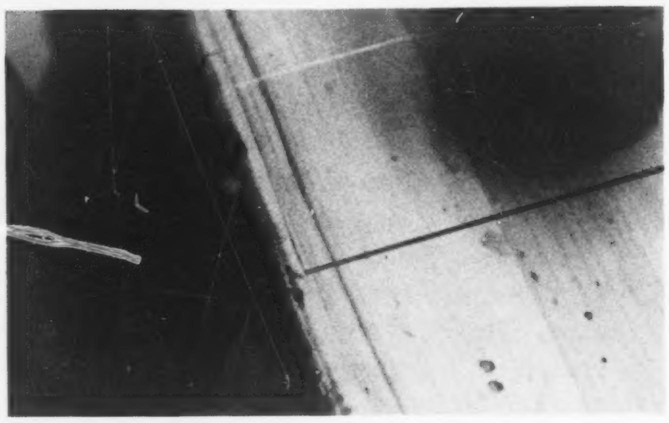


Fig. 64B-5. Separating Glass at Induced Fracture

Smoothing

8. Smooth the four edges of the 3″ x 3″ square of glass, using a sanding block and silicon carbide abrasive paper.

Masking

9. Draw a simple design or initial on a piece of 3″ x 3″ contact vinyl and shear the design with scissors and/or an X-acto® knife.
10. Apply the contact vinyl mask to one side of the 3″ x 3″ glass. See Fig. 64B-6.

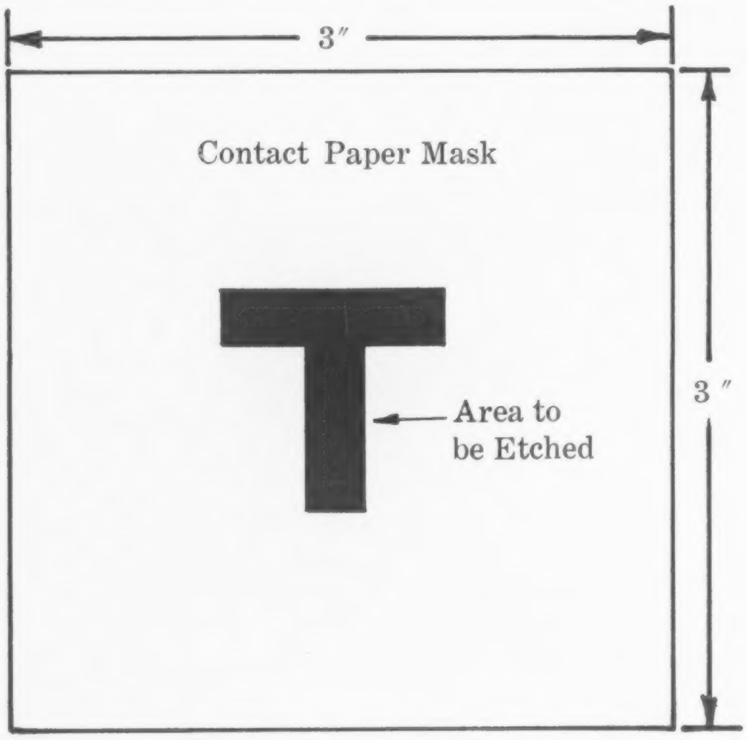


Fig. 64B-6. Contact Vinyl Mask Adhered to the Glass

Etching

11. Apply the etching cream directly from the tube on the exposed area outlined by the mask. **CAUTION:** Do not get the etching cream on your hands or clothing.
12. Etching will require about ten minutes. While the glass is being etched, clean up the equipment and supplies not being used. The equipment supervisor should return all unused materials to the teacher.
13. While waiting for etching to be completed, your teacher will demonstrate the fracturing of a curved piece of glass.
14. After the teacher's demonstration, wash the etching cream off your glass square and dry the glass with a paper towel. **CAUTION:** Edges of glass are sharp. Be careful that you don't cut yourself.
15. Remove and discard the contact vinyl mask.
16. Extra or unwanted pieces of glass should be returned to the teacher.

ACTIVITY 65A

Bonding

Today you will begin production of the components for a soft-faced mallet.

Problem

Objective

Using the proper equipment and supplies, cut off and lay out the handle for the soft-faced mallet.

Equipment (Group of 5)

5	12″ rules
2	8″ mill files, medium grade
1	ball peen hammer, 8 oz.
1	center punch

Equipment (Class)

1	miter box w/saw
1	8″ parallel clamp

Supplies (Group of 5)

3 pcs.	4½″ x 5″ abrasive paper, medium grit
1¼ pc.	½″ dia. x 36″ dowel rod

Preparing to Work

1. Assemble with your group at your work station and obtain the necessary supplies and equipment.
2. Study Fig. 65A-1. It shows a completed mallet.

Separating

3. Using the miter box, cut a 9″ length of ½″ dia. dowel. See Fig. 65A-2.
4. Round one end of dowel with a file.
5. Remove burr from other end of dowel with abrasive paper.

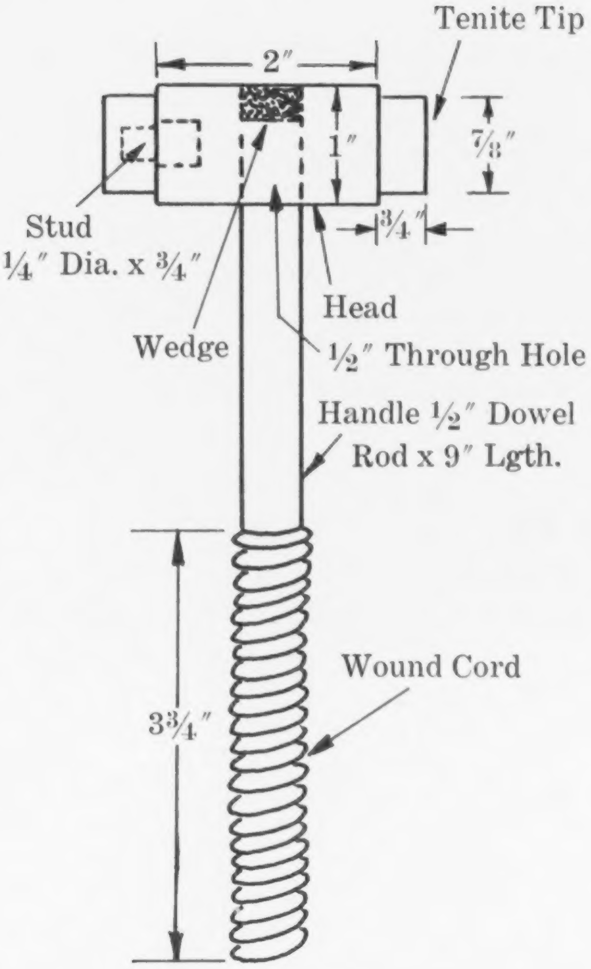

Tenite Tip
2″
1″
7/8″
3/4″
Stud
1/4″ Dia. x 3/4″
Head
Wedge
1/2″ Through Hole
Handle 1/2″ Dowel
Rod x 9″ Lgth.
Wound Cord
3 3/4″

Fig. 65A-1. Mallet Detail

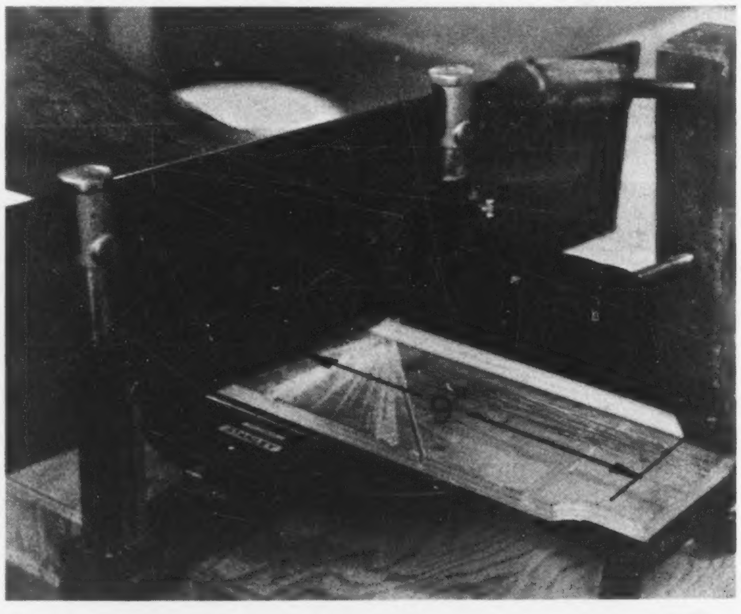


Fig. 65A-2. Cutting Dowel

Layout

6. Lay off a line 3¾″ up from rounded end of dowel with rule and pencil. See Fig. 65A-3.
7. Lay off a 9/64″ hole ¼″ up from rounded end with rule and pencil. See Fig. 65A-3.
8. Lightly center punch hole location.
9. Lay off a line ½″ down from squared end with rule and pencil. See Fig. 65A-3.
10. Label your workpiece with masking tape and store as directed by your teacher.

Cleaning Up

11. Return all equipment to equipment supervisor and clean up your work area.

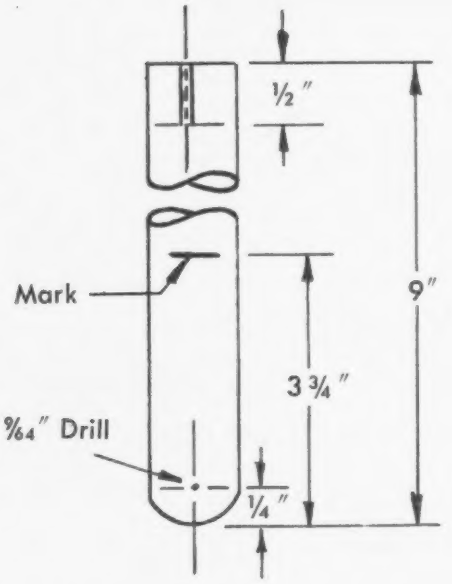


Fig. 65A-3. Layout Detail

ACTIVITY 65B

Bonding

Today you will finish the mallet handle that you started in yesterday's activity.

Problem

Objective

Using the proper equipment and supplies, prepare and bond the grip onto the stem of the handle for a soft-faced mallet.

Equipment (Group of 5)

1	hacksaw
1	hand drill
1	9/64″ twist drill
1 pr.	scissors
1	brush, paste
1	yardstick

Supplies (Group of 5)

1 btl.	white glue
25 ft.	1/8″ sash cord
1 roll	masking tape
1	paper towel

Preparing to Work

1. Meet with your regular group and get from the equipment supervisor the needed equipment and supplies.
2. Get your component from ACTIVITY 65A.

Safety

Safety supervisor check to see that safety glasses are worn while drilling.

Separating

3. With hand drill and 9/64″ twist drill, drill hole in rounded end of dowel at center punch mark. See Fig. 65B-1.
4. At opposite end of dowel, saw a slot down the center of the piece to 1/2″ mark. See Fig. 65B-2.
5. Measure cord to 60″ length with rule and cut off with scissors.
6. Fray 1″ on end of the cord. See Fig. 65B-3.

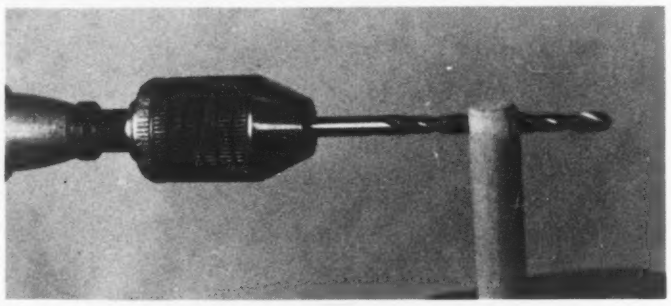


Fig. 65B-1. Drilling Hole

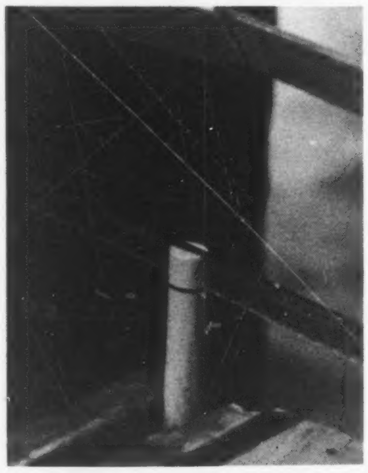


Fig. 65B-2. Cutting Slot

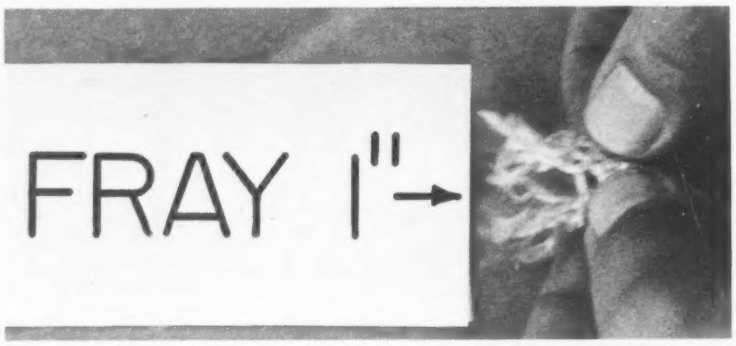


Fig. 65B-3. Fray End of Cord

Bonding

7. Apply glue to dowel from 3¾″ mark to round end with paste brush.
8. Lay frayed end of cord on handle at 3¾″ mark and hold with thumb. See Fig. 65B-4.
9. Wrap cord down handle to hole.
10. Insert cord through hole.
11. Pull cord tight.
12. Wipe off excess glue with paper towel.
13. Tape cord with masking tape to hold it in position while glue dries. See Fig. 65B-5.
14. Put your name on the tape. The recorder should store the handle for later assembly.

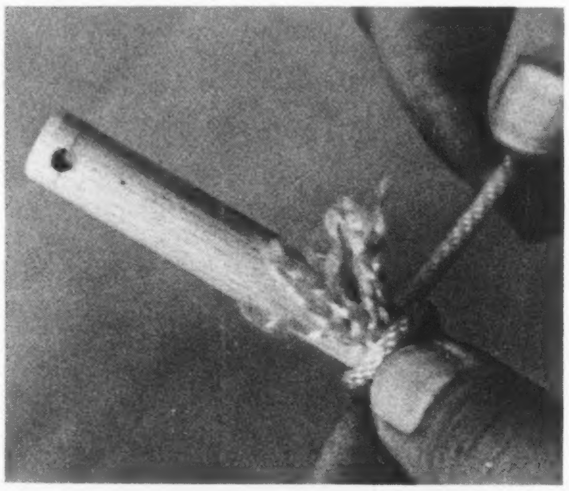


Fig. 65B-4. Holding Cord

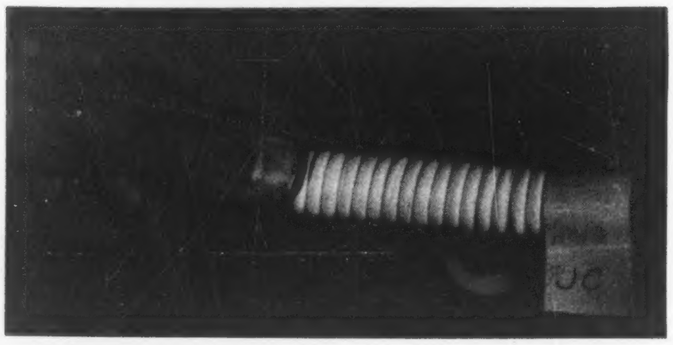


Fig. 65B-5. Taping

Cleaning Up

15. Return all equipment and supplies to equipment supervisor and clean the work area.
16. Answer the following questions.

Questions

1. The two major classes of bonding processes are a__________ bonding and f__________ bonding.
2. The cord grip is bonded to the stem of the mallet by a__________ bonding.
3. Indicate the *class* of bonding process used to combine each of the following:

Place a letter in front of each item to show your answer.
A = adhesive bonding
F = fusion bonding

a. ______ Joining auto body parts by resistance welding.

b. ______ Putting together copper pipe and fitting by soldering.

c. ______ Combining veneer in plywood by gluing.

d. ______ Joining basketball panel to body by gluing.

e. ______ Welding goalpost pipe together.

f. ______ Combining plastic sheets to form sandwich bags by melting and pressure.

g. ______ Joining plastic model parts with plastic "glue."

ACTIVITY 66A and B

Chip Removing

In today's activity you will produce components by various chip-removing processes that will later be combined into a soft-faced mallet.

Problem 1

Objective

Using necessary equipment and supplies, mark, center punch, drill, and taper a ½" *hole in the mallet head to receive the handle.*

Equipment (Work station No. 1)

1	drill press
1	½" twist drill
2	holding jig No. 121-1
1	Guide A for No. 121-1 for marking and counterpunching
1	Guide B for No. 121-1 for drilling
1	No. 2 *or* No. 9 taper pin reamer
1	metalworking vise
1 pr.	vise jaw guards
1	brace, wood
1	center punch

Supplies (Class)

25	Component 55C (workpiece)

Preparing to Work

1. Assemble in your designated group at the work station assigned to you.
2. Obtain your group's equipment and supplies from the equipment supervisor. Take them to your work station.
3. Foreman will assign jobs below.
4. Recorder will read Laboratory Manual and guide the work.

Safety

Safety supervisor should enforce the use of safety glasses when drilling.

Drilling

5. Using holding jig with Guide A, center punch your mallet head. See Fig. 66 A-1.
6. Place your workpiece in the holding jig mounted on drill press. Position workpiece so that it is flush with the end of the jig. See Fig. 66A-2.
7. Slide Guide B into position.
8. Drill ½" hole *through* workpiece. Hold workpiece firmly against end of the jig.
9. Slightly taper the ½" hole with a brace and taper ream. The largest end of the reamed hole will be the *top* of the mallet head.
10. Have your workpiece checked by your teacher before moving to next work station. Your teacher will direct you to the next work station.

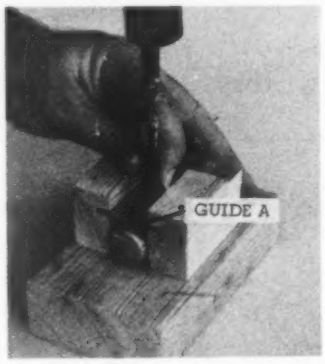


Fig. 66A-1. Center-Punching

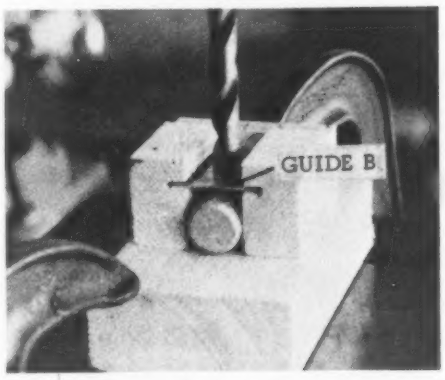


Fig. 66A-2. Positioning and Drilling of Workpiece

Problem 2

Objective

Using the proper equipment and supplies, drill and tap the stud holes in the mallet head.

Equipment (Work station No. 2)

2	10″ files, coarse
1	file cleaner
1	electric hand drill
1	$\frac{13}{64}$″ twist drill
1	tap wrench
1	$\frac{1}{4}$″-20 bottom tap
1	drill jig, No. 121-2
1	tapping jig, No. 121-3

Supplies (Work station No. 2)
1 roll masking tape

Preparing to Work

1. Assemble in your designated group at the work station assigned to you.
2. Obtain your group's equipment and supplies from the equipment supervisor. Take them to your work station.

Safety

The safety supervisor will enforce the following:

a. Use safety glasses when drilling and when tapping.
b. Do not *force* a tap if it binds.

Drilling

3. Touch up corners of workpiece with a file as needed.
4. Using *Drilling Jig* No. 121-2 to guide the twist drill, drill a $\frac{13}{64}$″ hole $\frac{3}{8}$″ deep in each end of the mallet head. See Fig. 66A-3.

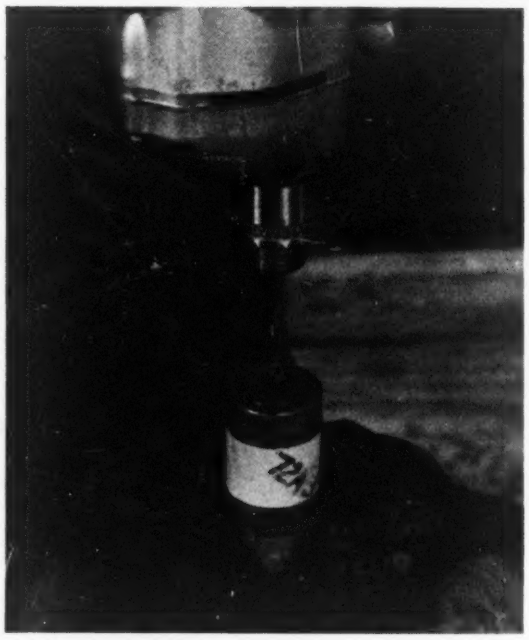


Fig. 66A-3. Drilling Head

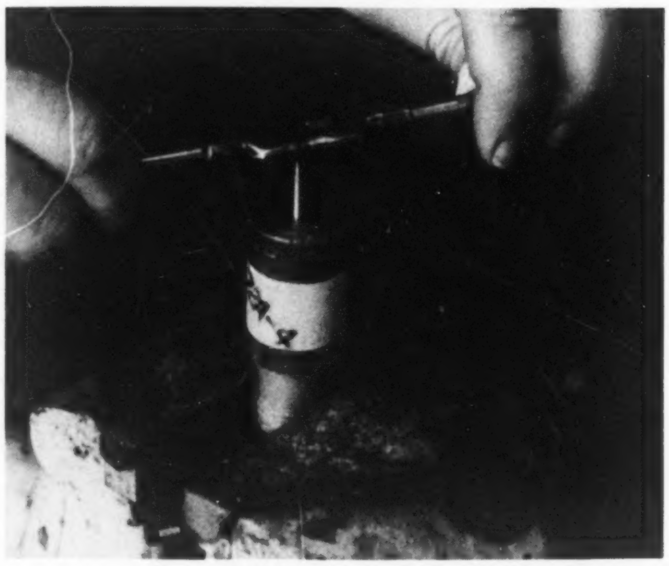


Fig. 66A-4. Tapping

Tapping

5. Using *Tapping Jig* No. 121-3 to guide the tap, cut threads in each end of the mallet head. *Back* tap frequently and *clear* chips from hole often. Lubricate well and *do not* force tap. See Fig. 66A-4.
6. Have workpiece checked by your teacher before moving to next work station. The teacher will direct you to the next work station.
7. Mark your workpiece with a piece of tape, then record and store it before moving to the next work station.

Problem 3

Objective

Using necessary equipment and supplies, make the studs used to connect the plastic tips to the mallet head.

Equipment (Work station No. 3)

2	vise
2 prs.	vise-jaw guards
2	hacksaw
2	10″ mill file, smooth
2	6″ adjustable wrench
8	¼″-20 nuts

Supplies (Work station No. 3)

1 roll	1″ masking tape
2	20 inch ¼″-20 threaded rods

Preparing to Work

1. Assemble in your designated group at the work station assigned to you.
2. Obtain your group's equipment and supplies from the equipment supervisor. Take them to your work station.

> **Safety**
>
> The safety supervisor should see that the students do not hold the top frame of the hacksaw when sawing.

Cutting Studs

3. Put four ¼″-20 nuts on the length of threaded rod to protect threads. See Fig. 66A-5.
4. Place threaded rod in a vise and using a hacksaw, cut off a ¾″ length. This will be a stud. See Fig. 66A-6.
5. Using the file, lightly touch up any burrs on the ends of the stud. *Do not* file more than necessary.
6. Back the two nuts off the stud to re-chase any threads that are damaged.
7. Repeat Steps 3-7 to manufacture another stud.
8. Have your workpieces checked by the teacher before moving to the next work station. The teacher will direct you to the next work station.

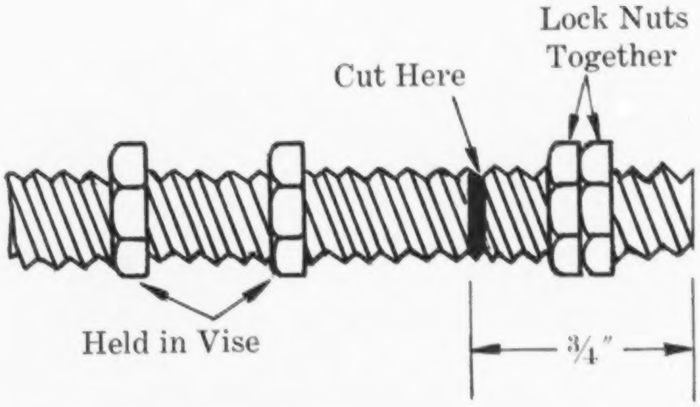


Fig. 66A-5. Position of Nuts

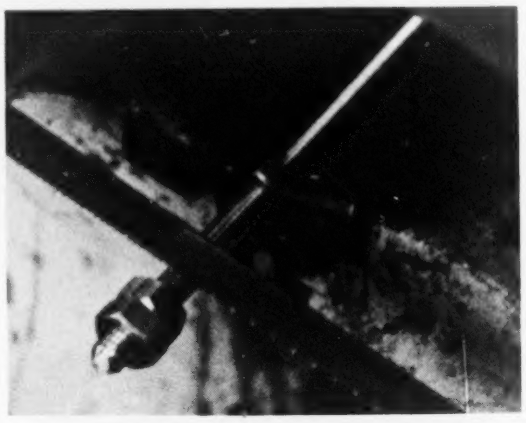


Fig. 66A-6. Cutting Off a ¾″ Stud

9. Mark your workpiece with a piece of tape, record, and then store in designated area.

Problem 4

Objective

Using the necessary equipment and supplies, cut off material for manufacturing soft tips for a mallet head.

Equipment (Work station No. 4)

1	miter box with saw
1	parallel clamp

Supplies (Work station No. 4)

12	4½″ x 5½″ abrasive paper, fine grit
40″	⅞″ dia. tenite rod

Preparing to Work

1. Assemble in your designated group at the work station assigned to you.
2. Obtain your group's equipment and supplies from the equipment supervisor. Take them to your work station.

> **Safety**
>
> The safety supervisor should see that students' hands are kept well clear of saw blade when holding a workpiece.

Sawing

3. Using the miter box, cut a 1½" length of tenite plastic. See Fig. 66A-7.
4. Use abrasive paper to smooth out the ends. See Fig. 66A-8.
5. Have workpiece checked by your teacher before moving to next work station. The teacher will direct you to the next work station.

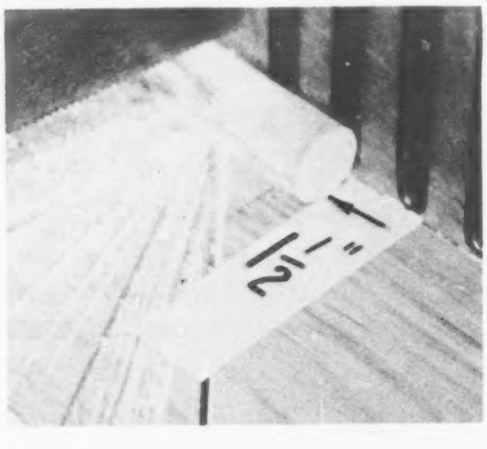


Fig. 66A-7. Sawing Tenite Rod

Fig. 66A-8. Smoothing Ends

Problem 5

Objective

Using the necessary equipment and supplies, drill and thread a piece of tenite plastic rod to make removable tips for a soft-faced mallet.

Equipment (Work station No. 5)

2	hand drill
2	13/64" twist drill
2	vise, metalworking 4"
2 prs.	vise-jaw guards
2	1/4"-20 tap, bottom
2	tap wrenches
1	drill jig No. 121-4
1	tapping jig No. 121-5

Supplies (Class)

25	7/8" x 1½" tenite rods, cut in Problem 4

Preparing to Work

1. Assemble in your designated group at work station assigned to you with component cut in Problem 4.

Drilling

2. Place your workpiece in a vise.
3. Use *Drilling Jig* No. 121-4 to guide the twist drill and drill a 13/64" hole 3/8" deep with a hand drill. See Fig. 66A-9.

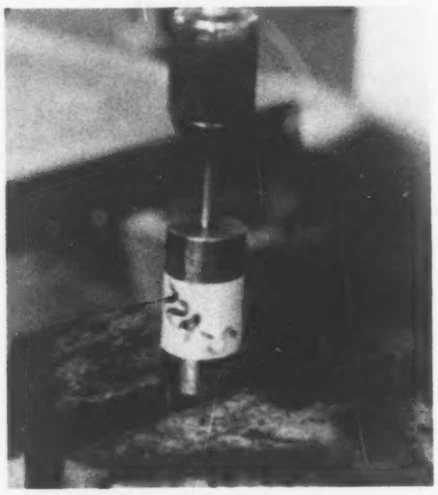


Fig. 66A-9. Drilling Tips

Tapping

4. Using *Tapping Jig* No. 121-5 to guide the tap, cut threads in each end of the tenite rod. Back tap carefully to avoid tearing out threads in the soft plastic. Observe the tap cutting threads.
5. Have workpiece checked by your teacher before moving to next work station. The teacher will direct you to the next work station.

Problem 6

Objective

Using the necessary equipment and supplies, cut off and polish two plastic tips to be fastened to the mallet head.

Equipment (Work station No. 6)

1	miter box with saw
2	10″ files, mill, smooth
1	file cleaner
1	parallel clamp

Supplies (Work station No. 6)

12 pcs. 4½″ x 5½″ abrasive paper, fine grit

Supplies (Class)

25 ⅞″ x 1½″ tenite rods from Problem 5

Preparing to Work

1. Assemble in your designated group at the work station assigned to you with component drilled and tapped in Problem 5.

Safety

> The safety supervisor should see that students' hands are kept clear of the saw blade when holding a workpiece.

Sawing

2. Using the miter box, cut the tenite rod in half. Use a clamp to hold the rod while cutting. See Fig. 66A-10.

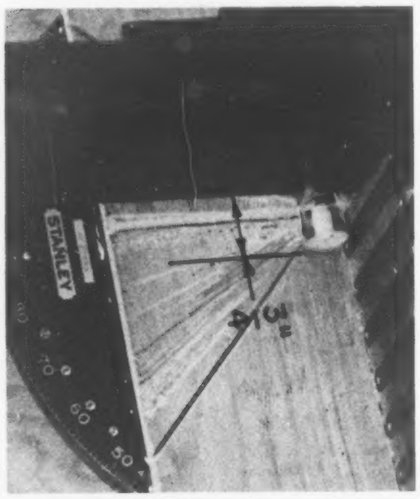


Fig. 66A-10. Cutting Tips

Polishing

3. File a chamfer on each tip. See Fig. 66A-11.
4. Smooth the ends, using abrasive paper as in Problem 4. See Fig. 66A-8.
5. Have workpiece checked by your teacher before moving to next work station. The teacher will direct you to the next work station.
6. Label your component with tape, record, and store it in designated area.

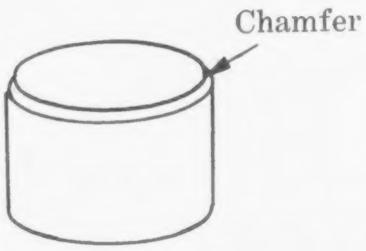


Fig. 66A-11. Chamfer

ACTIVITY 67

Coating

Today you will spray-coat and dip-coat component 65B, hammer handle.

Problem

Objective

Using proper equipment and supplies:
- a. Spray-coat one-half of the handle.
- b. Dip-coat corded portion of the handle.

Equipment (Group of 5)

2 pr.	scissors
2	X-acto® knives

Supplies (Group of 5)

5 pcs.	duplicator paper
1 can	rubberized vinyl, 13 oz.
1 can	enamel spray, at spray booth

Preparing to Work

1. Meet with your group and obtain your supplies.
2. Cut a ½″ diameter hole in the center of a sheet of paper.
3. Place the paper mask on the handle until it rests on top of the corded portion. See Fig. 67-1.

Coating

4. Spray one end of the handle with spray enamel. Allow handle to dry before removing paper mask.
5. When the sprayed end of the handle has dried, hold the dry, sprayed end in your hand and dip the corded portion into the rubberized vinyl. See Fig. 67-2.
6. After the rubberized vinyl has dried, store the handle until final assembly.

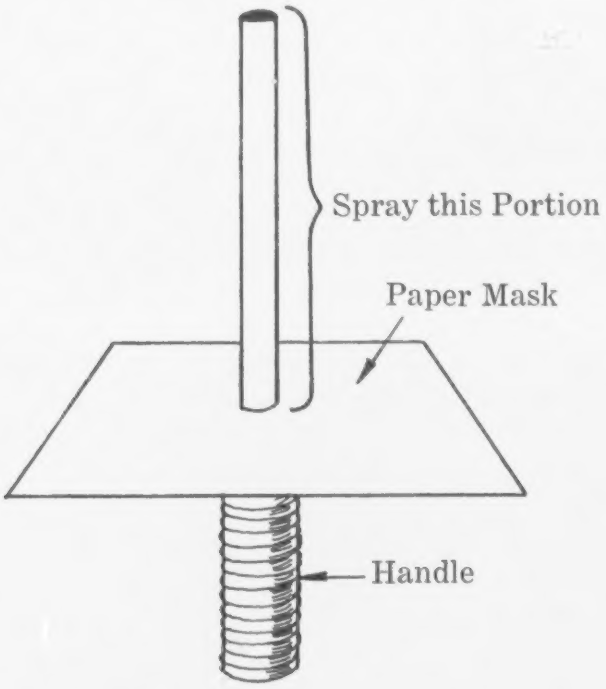


Fig. 67-1. Mask for Spray Coating Handle

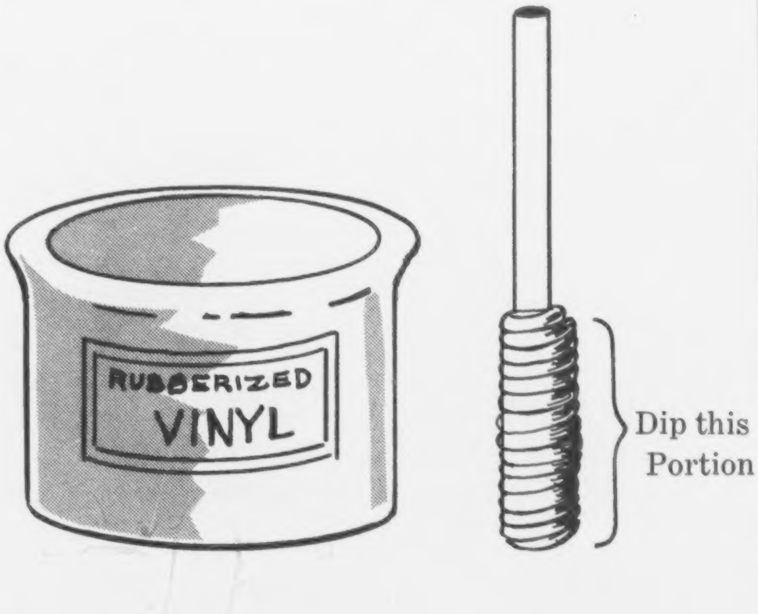


Fig. 67-2. Setup for Dipping Handle

ACTIVITY 68

Mechanical Fastening

In today's activity you will combine components by mechanical fastening.

Problem

Objective

Using components that you have made for your mallet, you will assemble by mechanical fastening.

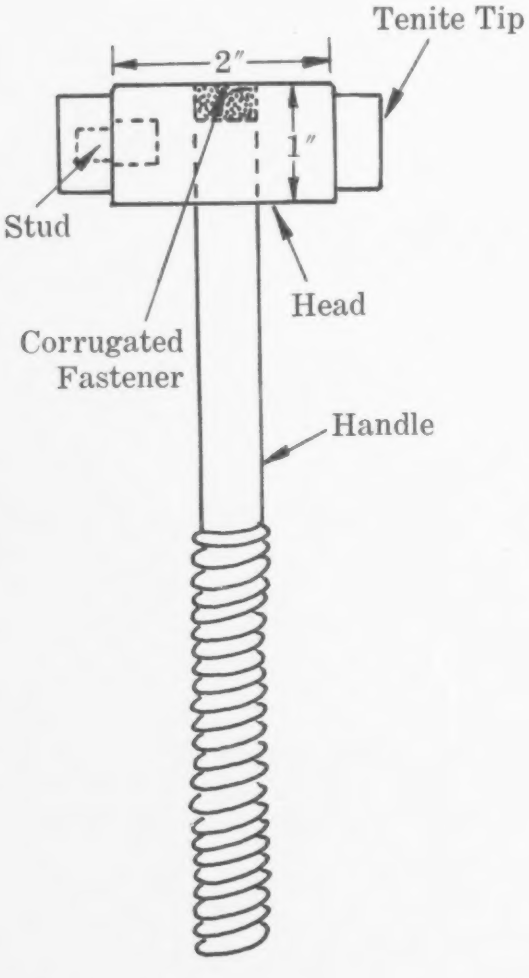


Fig. 68-1. Completed Mallet

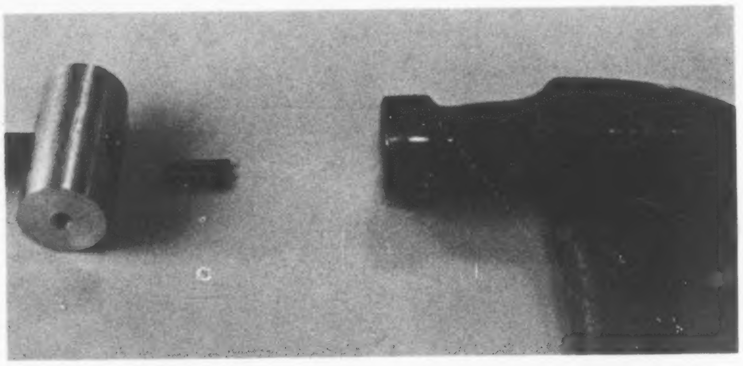


Fig. 68-2. Fastening Mallet Head

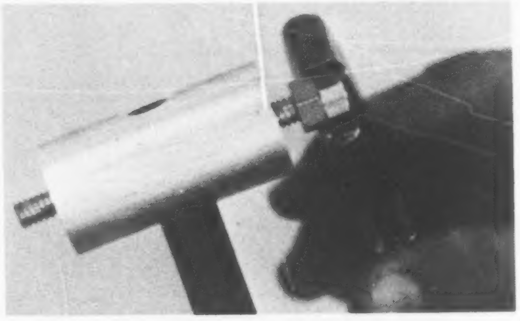


Fig. 68-3. Tightening Nuts

Equipment (Group of 5)

2	7 oz. claw hammers
1	adjustable wrench, 6″
2	¼″-20 hex nuts

Supplies (Per student)

1	cast mallet head, ACTIVITY 55C
1	9″ handle, ACTIVITY 65B
2	tenite tips, ACTIVITY 66B
2	¼″-20 x ¾″ studs, ACTIVITY 66B
1	No. 4 corrugated fastener, ½″

Preparing to Work

1. Assemble with your group at your work station and obtain the necessary supplies and equipment.
2. Study Fig. 68-1. It shows a completed mallet.

Assembly

3. Insert the handle into the mallet head and fasten it with a corrugated fastener. See Fig. 68-2.
4. Thread both studs into mallet head by locking two nuts and tighten with a wrench. See Fig. 68-3.

5. Thread the tenite tips onto the head. See Fig. 68-4.

Cleaning Up

6. Clean up your work area and return all equipment and supplies.

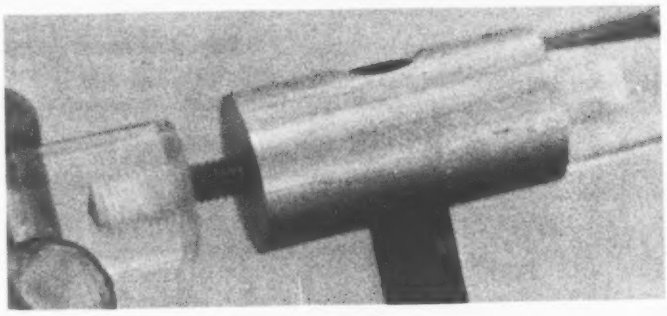


Fig. 68-4. Threading Tenite Tips

Fig. 68-5. Process Checklist (Mallet)
Circle the number of each process you used in manufacturing the mallet. Identify the technique that you used in each process checked.

		Process	Part	Techniques
Example 1	Forming	Casting or Molding	Head	One-Shot Molding
2		Compressing and Stretching		
3		Conditioning		
4	Separating	Chip Removing	Head, handle	
5		Shearing	Rope	
6		Other Separating Processes		
7	Combining	Mixing		
8		Bonding	Rope to handle	
9		Mechanical Fastening	Tips to head Handle to head	
10		Coating	Handle Handle grip	

Questions

1. What two classes of mechanical fasteners are used in the mallet?

   th__________ and __________.

2. The threaded rods that extend from the mallet head are called

   ______________.

3. Cutting internal threads is called

   ______________.

4. The force that holds the mallet head on the handle is ______________.

5. Painting the head and dipping the handle in vinyl are examples of combining by

   ______________.

6. List four types of threaded mechanical fasteners.

   a. ______________

   b. ______________

   c. ______________

   d. ______________

7. List four types of nonthreaded mechanical fasteners.

   a. ______________

   b. ______________

   c. ______________

   d. ______________

8. Complete Fig. 68-5, Process Checklist (Mallet).

ACTIVITY 69

Mixing

Today you will make a polyurethane foam "sponge."

Problem

Objective

Using the proper equipment and supplies, manufacture a flexible, expanded foam sponge to simulate industrial practices.

Equipment (Group of 5)

3	12″ rules
1	stapler with staples

Supplies (Group of 5)

5	plastic sandwich bags
5	3 oz. paper cups
5	stirring sticks

Supplies (Per student)

½ oz. each, prepolymer *A* & catalyst *B*, flexible polyurethane foam components

Preparing to Work

1. Assemble with your group and the equipment supervisor will obtain the supplies and equipment.

Marking the Cup

2. Using a pencil and a rule, mark a line inside the paper cup as directed by the teacher. See Fig. 69-1.
3. Using a pencil and a rule, mark another line inside the paper cup as directed by the teacher.
4. The teacher will place two different liquid materials in your paper cup using your lines as a guide.

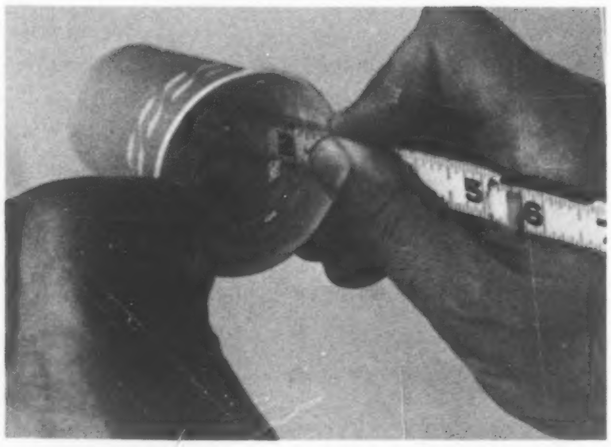


Fig. 69-1. Marking Line

Safety

a. Do not spill foam ingredients on your clothing or skin.
b. Avoid breathing fumes from the mixture.
c. Do not pour foam ingredients into the sink or drain.

Preparing the Mold

5. Fold the side of the plastic bag over several times to make it about one-half of the original size and staple the folded side. See Fig. 69-2.

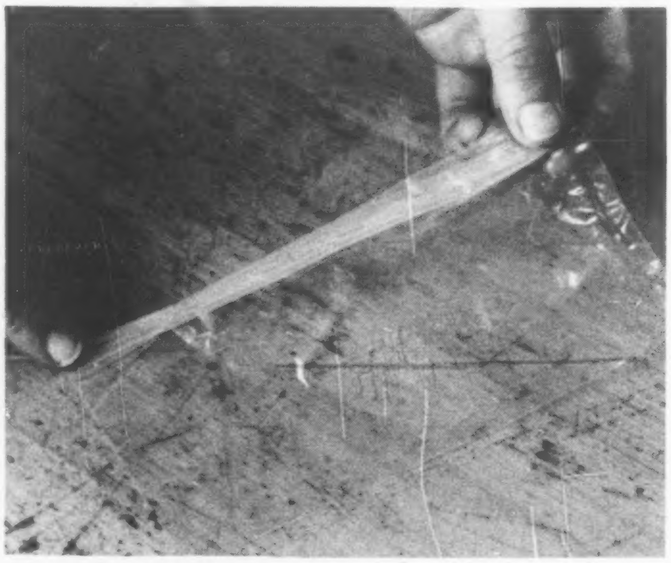


Fig. 69-2. Folding Bag

Mixing

6. Mix the two materials together by *stirring* with a stirring stick. The two components must be *stirred* thoroughly to cause the *chemical reaction.*

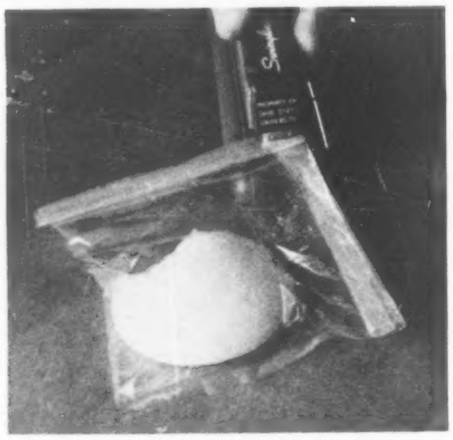


Fig. 69-3. Stapling Bag

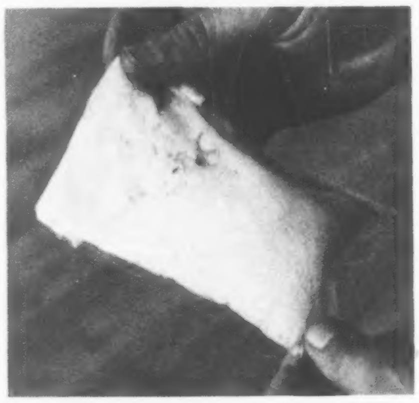


Fig. 69-4. Foam Expanded

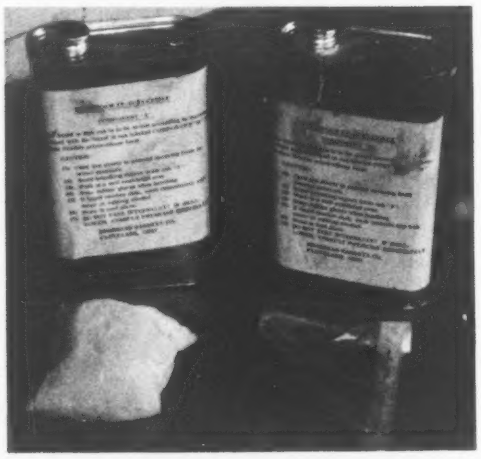


Fig. 69-5. Finished Sponge

Pouring

7. Have another student hold the bag open so that you can pour the *mixed* materials from the cup into the plastic bag.
8. Hold the top of the bag, double it over, and staple it closed. See Fig. 69-3.
9. Hold the bag and observe the foam as it expands. See Fig. 69-4.

Cleaning Up

10. After chemical reaction stops, place plastic bag on your bench and clean up your work area. Equipment supervisor returns all equipment.
11. Answer the questions at the end of this laboratory activity.
12. In the next class meeting you will peel plastic bag from foam and remove "sponge." See Fig. 69-5.

Questions

1. Which kind of mixture operation did you use in today's activity?

    ____

2. The components you mixed to make foam were in what form?

    ____

3. The ingredients for making the foam had

    ______________ (high, low) viscosity.

4. What would happen if you did not mix these components enough?

    ____

    ____

5. A ch______________ re______________

    took place to cause the mixture to foam and expand when the components were properly mixed.

6. Did you notice a temperature change in the materials as the mixture changed from liquid to solid?

    ____ Yes ______ No

ACTIVITY 70A-G

Combining Subassemblies

In this group of activities you will produce a product by one of the two major assembly processes.

Problem 1

Objective

Using subassemblies and a set of drawings, analyze a product, determine the components to be manufactured, and determine the processes to be used in manufacturing the components.

Fig. 70A-2. Parts List for Utility Box

Part Number	Part Name
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Planning Production

1. Study the exploded view drawing, Fig. 70A-1, to determine the components and subassemblies to be manufactured.
2. Your teacher will discuss with you the components and subassemblies that must be manufactured and the processes that might be used in their manufacture.
3. Complete the Parts List on Fig. 70A-2. (Refer back to Fig. 70A-1.)
4. According to the directions your teacher has given you, complete the Route Sheet for a bottom of the utility box. See Fig. 70A-3. (Part number 1 on Fig. 70A-1.)

Problem 2

Objective

Using the necessary equipment and supplies and a set of route sheets, fabricate and assemble the necessary components and subassemblies to produce a utility box.

Equipment (Class)

1	squaring shear
2	scratch awl
1	template No. 126-1
1	template No. 126-2
1	drill fixture No. 126-3
1	locating die No. 126-4A & B
5	2″ Handy® spring clamp
6	8 oz. ball peen hammer
2	center punch
1	box and pan brake
2	miter box with saw
1	electric hand sander
1	drill press
4	aviation snips
2	$\frac{1}{8}$″ hand punch
1	hand drill
1	metalworking vise
2 sets	pop rivet gun
1	bench knife
1	hacksaw
1	$\frac{11}{64}$″ twist drill
1	$\frac{3}{16}$″ twist drill
1	12″ rule

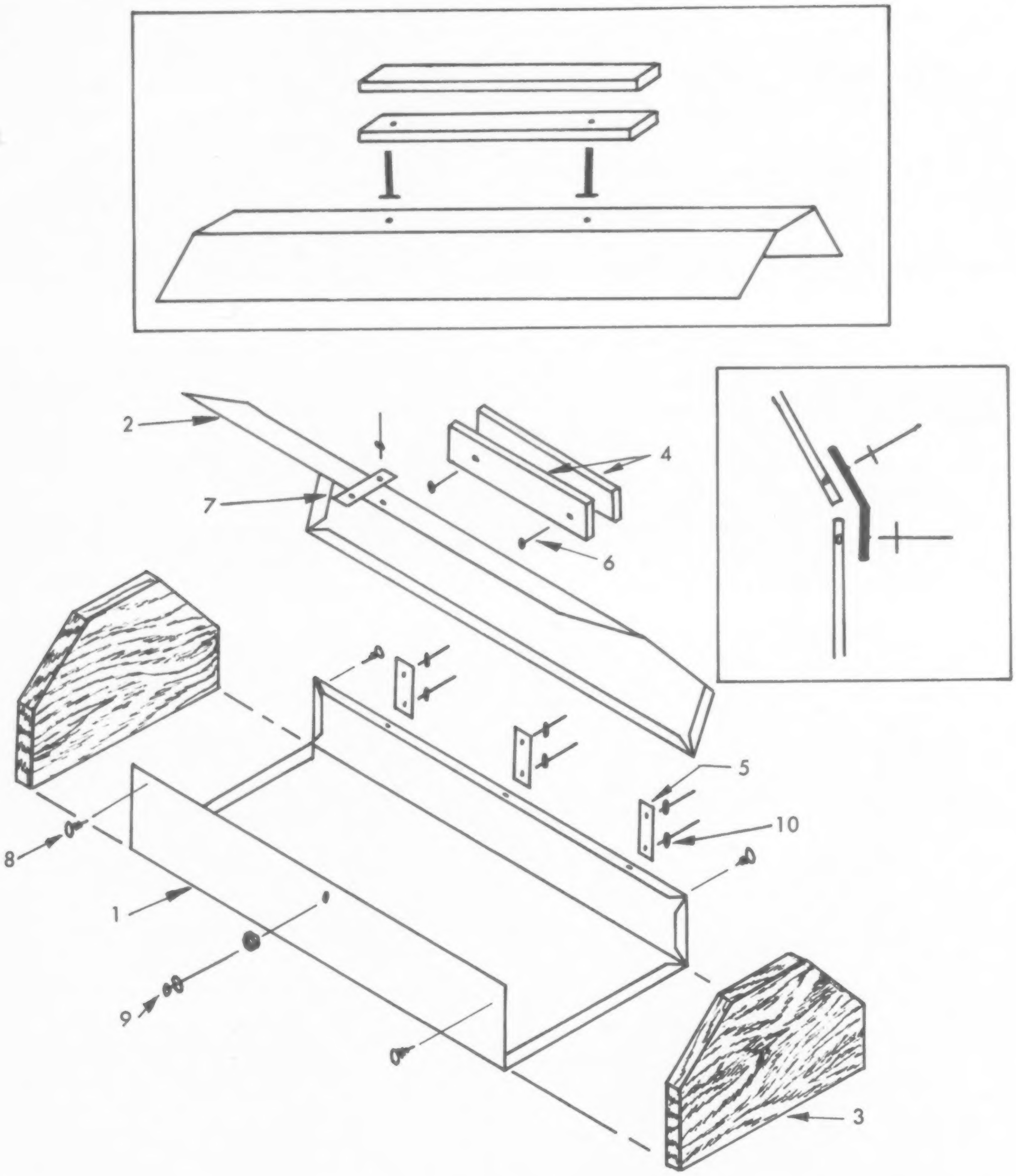


Fig. 70A-1. Exploded-View Drawing

1	8″ file, mill
1	10″ file, smooth
6	screwdriver
	2″ spring clamps
2	4″ x 6″ wood block thickness
1	paper cutter *or* scissors
1	small brush
1	cardboard box (spray booth)
1	felt tip pen

Supplies (Per student)

1 pc.	tin plate, 14″ x 20″, 30 gage
1 pc.	wood, ½″ x 3⅝″ x 12″
1 pc.	polyethylene, .060 thickness, ½″ x 5″
1 pc.	acrylic plastic, ¼″ x ¾″ x 6″, opaque
1 pc.	acrylic plastic, ¼″ x ¾″ x 6″, clear
2	nails, 10d common
8	screws, No. 4 x ½″ PH sheet metal

Fig. 70A-3. Route Sheet for Utility Box Bottom

Part Name Utility Box Bottom Part No. 1 Material tin plate

Component ☐ Number of Pieces Needed Per Assembly ______ Stock Size 14″ x 20″

Subassembly ☐ ______

Final Assembly ☐

OPERATION NUMBER	DESCRIPTION OF OPERATIONS	MACHINE	TOOLS, JIGS	SUPPLIES
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

7	pop rivets, 1/8″ dia. 1/8″ length
1	pop rivet, 1/8″ dia. 1/4″ length

Supplies (Class)

2 shts.	aluminum oxide, abrasive paper No. 120 grit
1 can	spray paint, any color
5 shts.	duplicator paper
1 qt.	ethylene dichloride
1 qnty.	epoxy glue
5 shts.	silicon carbide, wet-dry abrasive paper, medium grit

Preparing to Work

1. You will be working on this product for the next few assignments and will be producing the necessary components and subassemblies. Work each day as your teacher directs you.

2. Following your teacher's directions, assemble with your group and obtain your equipment and supplies.

Producing Components and Subassemblies

3. Begin production of components and subassemblies. Continue until your teacher directs you to stop. Refer to the route sheets for each component, Figs. 70A-3 through 10.

4. At the end of the period, store all components as directed by the teacher. Return all equipment and clean up your work area.

5. You will complete Fig. 70A-11 after the utility boxes have been assembled.

Fig. 70A-4. Route Sheet for Utility Box Top

Part Name Utility Box Top

Part No. 2

Material tin plate

Component ☐

Number of Pieces Needed Per Assembly 1

Stock Size 8¾″ x 14″

Subassembly ☐

Final Assembly ☐

OPERATION NUMBER	DESCRIPTION OF OPERATIONS	MACHINE	TOOLS, JIGS	SUPPLIES
1	Cut stock to size 8¼″ x 14″	squaring shear		
2	Scribe shape on stock		template No. 126-5, scratch awl	
3	Center punch hole locations		template No. 126-5, hammer, center punch	
4	Shear corners and notches		tin snips	
5	Bend hems	box and pan brake		
6	Flatten hems		hammer, wood block	
7	Punch ⅛″ holes		⅛″ hand punch	
8	Drill 3/16″ holes		hand drill, 3/16″ twist drill	
9	Bend sides 45°	box and pan brake		
10				

Fig. 70A-5. Route Sheet for Ends

Part Name Ends
Part No. 3
Material wood

Component ☐
Number of Pieces Needed Per Assembly 2
Stock Size ½″ thickness
3⅝″ wide

Subassembly ☐

Final Assembly ☐

OPERATION NUMBER	DESCRIPTION OF OPERATIONS	MACHINE	TOOLS, JIGS	SUPPLIES
1	Cut stock to length 6″		miter box w/saw stop block	
2	Cut two corners 45°		miter box w/saw stop block	
3	Sand all surfaces		electric hand sander	sandpaper
4	Finish		spray booth	spray paint
5				
6				
7				
8				
9				
10				

Fig. 70A-6. Route Sheet for Handle

Part Name Handle
Part No. 4
Material acrylic plastic

Component ☐
Number of Pieces Needed Per Assembly 1
Stock Size ¼″ thickness ¾″ wide

Subassembly ☐

Final Assembly ☐

OPERATION NUMBER	DESCRIPTION OF OPERATIONS	MACHINE	TOOLS, JIGS	SUPPLIES
1	Cut clear stock to 6″ length		miter box w/saw stop block	
2	Cut opaque stock to 6″ length		miter box w/saw stop block	
3	Cut paper name plate		paper cutter or scissors	duplicator paper
4	Print name		felt tip pen	
5	Assemble and clamp		spring clamp — 2″	
6	Bond		small brush	ethylene dichloride
7	Drill two $\frac{11}{64}$″ holes	drill press	drill fixture No. 126-10, $\frac{11}{64}$″ twist drill	
8	File		fine file	
9	Sand			wet or dry sandpaper
10				

Fig. 70A-7. Route Sheet for Hinge

Part Name Hinge
Part No. 5
Material Polyethylene
Component ☐
Number of Pieces Needed Per Assembly 3
Stock Size .606″ thickness ½″ wide 5″ long
Subassembly ☐
Final Assembly ☐

OPERATION NUMBER	DESCRIPTION OF OPERATIONS	MACHINE	TOOLS, JIGS	SUPPLIES
1	Mark hole locations		locating die 126-17A and B, hammer	
2	Cut to length		locating die 126-17B hammer	
3	Punch ⅛″ holes		⅛″ punch	
4				
5				
6				
7				
8				
9				
10				

Fig. 70A-8. Route Sheet for Studs

Part Name Studs

Part No. 6

Material nail

Component ☐

Number of Pieces Needed Per Assembly 2

Stock Size 10d

Subassembly ☐

Final Assembly ☐

OPERATION NUMBER	DESCRIPTION OF OPERATIONS	MACHINE	TOOLS, JIGS	SUPPLIES
1	Layout length 1½″		ruler	
2	Cut to length		vise, hacksaw	
3	File burrs		file	
4				
5				
6				
7				
8				
9				
10				

Fig. 70A-9. Route Sheet for Hasp

Part Name Hasp

Part No. 7

Material Polyethylene

Component ☐

Number of Pieces Needed Per Assembly 1

Stock Size .060″ thickness ½″ wide, 2″ long

Subassembly ☐

Final Assembly ☐

OPERATION NUMBER	DESCRIPTION OF OPERATIONS	MACHINE	TOOLS, JIGS	SUPPLIES
1	Punch ⅛″ holes		⅛″ hand punch	
2	Cut slit		knife	
3				
4				
5				
6				
7				
8				
9				
10				

Fig. 70A-10. Route Sheet for Utility Box Assembly

Part Name Utility Box Assembly **Part No.**__________ **Material**__________

Component ☐ **Number of Pieces Needed Per Assembly**______ **Stock Size**__________

Subassembly ☐

Final Assembly ☐

OPERATION NUMBER	DESCRIPTION OF OPERATIONS	MACHINE	TOOLS, JIGS	SUPPLIES
1	Assemble ends to bottom		screwdrivers	6″ x ½″ PH sheet metal screws
2	Fasten hinges to bottom subassembly		pop riveter	⅛″ x ⅛″ pop rivets
3	Fasten top to bottom subassembly		pop riveter	⅛″ x ⅛″ pop rivets
4	Fasten hasp to top		pop riveter	⅛″ x ⅛″ pop rivets
5	Fasten hasp stud		pop riveter	⅛″ x ¼″ pop rivets
6	Insert studs through top			
7	Bond studs to handle			epoxy
8				
9				
10				

Fig. 70A-11. Process Checklist (Utility Box)

Circle the number of each process you used in manufacturing the utility box. Identify the technique that you used in each process checked.

		Processes	Part	Techniques
1	**Forming**	Casting or Molding	top, bottom	
2		Compressing and Stretching	top, bottom	
3		Conditioning		
4	**Separating**	Chip Removing	ends studs handle	
5		Shearing	name plate hinge	
6		Other Separating Processes		
7	**Combining**	Mixing		
8		Bonding	handle, studs to handle	
9		Mechanical Fastening	rivets	
10		Coating	ends	

ACTIVITY 70H

Combining Subassemblies

For the past few days you have been studying ways to combine components into subassemblies by mixing, coating, bonding, or mechanical fastening. Today you will combine subassemblies into a finished product using the *continuous assembly* approach.

Problem

Objective

1. Using proper equipment and supplies, combine subassemblies to make two runs of five socket, wire, and plug assemblies.
2. Given the time and observing workmanship of two production runs, determine if production time of the second run was lowered without loss of quality.

Equipment (Group of 5)

1 pr.	wire strippers
1	4″ common screwdriver
1 pr.	diagonal cutters

Supplies

5	sockets, 75w, 250-volt
5	#18-2 lamp cords, any length
5	plugs, snap-on type
1	small box *or* paper bag
5	nipples with hex nut, ½″ x ⅜″ dia.

Preparing to Work

1. Meet with your group and equipment supervisor will obtain your equipment and supplies.
2. Arrange the supplies neatly in the middle of the table.
3. The foreman should assign Jobs A through D to four students. The foreman is to perform Job E.

   Job A—Split, strip, twist cord
   Job B—Disassemble socket
   Job C—Install wire
   Job D—Assemble socket
   Job E—Install plug
4. The group recorder should make a note of the time required to produce five assemblies. Jobs A through E, performed on five sets of parts.

Combining Subassemblies

5. JOB A—Split one end of the lamp cord 1½″ and strip ¾″ of insulation from each wire. See Figs. 70H-1 and 70H-2. *Twist the stripped ends CLOCKWISE.*

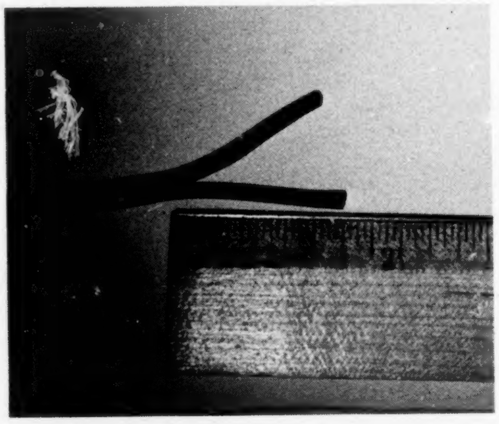


Fig. 70H-1. Split Cord

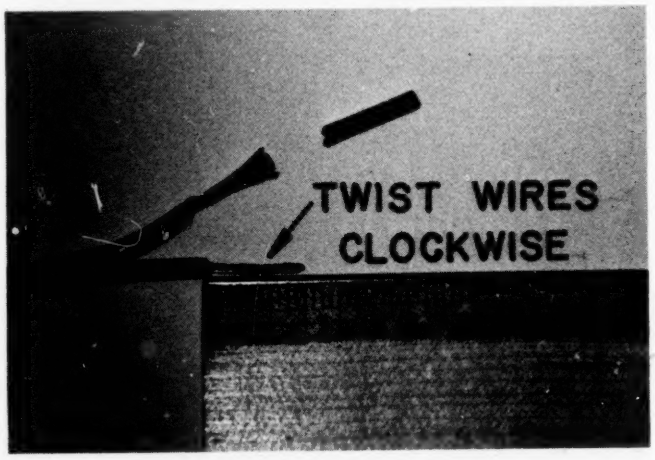


Fig. 70H-2. Strip Insulation

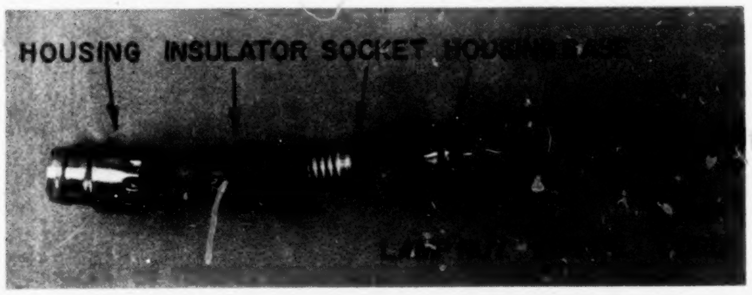


Fig. 70H-3. Disassembled Socket

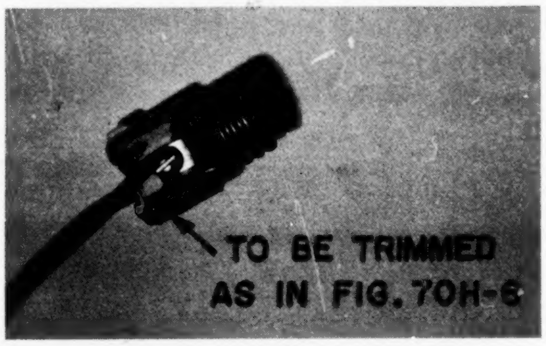


Fig. 70H-4. Wire Installation

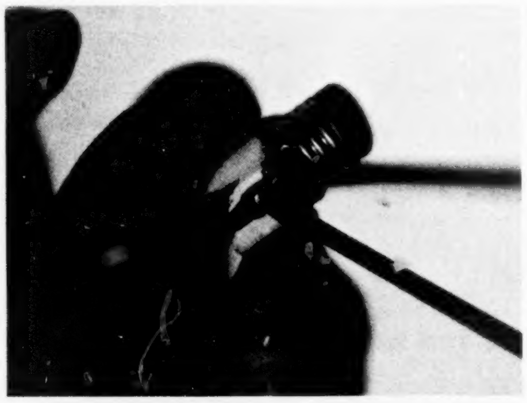


Fig. 70H-5. Tightening Screw

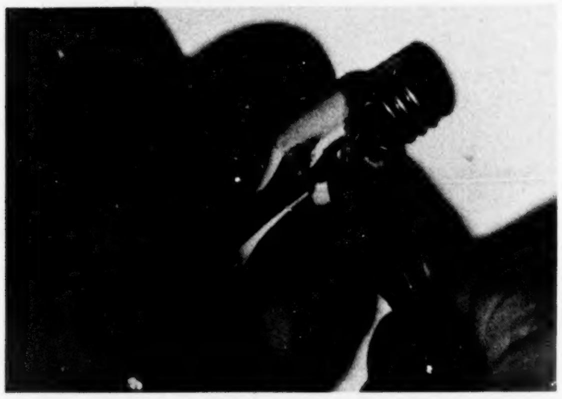


Fig. 70H-6. Trimming Wire

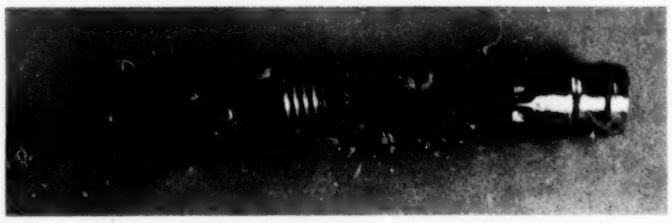


Fig. 70H-7. Socket Assembly

Fig. 70H-8. Plug Assembly

6. JOB B—Disassemble a socket. See Fig. 70H-3.
7. JOB C—Install each wire *clockwise* around a screw, drawing the insulation up to the screw. Tighten the screw. See Figs. 70H-4 and 70H-5. Trim surplus wire from the screw with the diagonal cutter. See Fig. 70H-6.
8. JOB D—Loosely assemble the lamp socket parts. Do not snap together. See Fig. 70H-7.
9. JOB E—Install the snap-on plug. See Fig. 70H-8.
10. When five assemblies are completed, one student should cut the wire just below each socket and another student should remove the plugs.
11. Begin production again. See if your group can reduce production time *without* lowering *job quality*.

Safety

Do not plug finished assembly into an outlet.

Cleaning Up

12. When the timekeeper announces clean up time, return equipment and supplies

neatly to the original positions at the middle of the table. Wires attached to sockets should be cut close to the socket. Plugs should be removed from wires.

13. The group foreman should deliver to the teacher (in the paper or box provided) five sockets, five cords, and five plugs.

The equipment supervisor should return a wire stripper, a screwdriver, and a pair of diagonal cutters to storage area.

14. Remaining students in the group should clean up all scraps of wire and insulation.

ACTIVITY 71

Preparing for Distribution

In today's activity you will complete a Package Analysis Chart. As a group you will discuss the advantages and disadvantages of how the product is related to its packaging.

Problem

Objective

Using the packages provided and a Package Analysis Chart, analyze how the package protects, identifies, and facilitates handling and storing of the product.

Supplies (Class)

1	egg carton
1	cola case, 6-pack carton
1	soft drink bottle and cap
1	plastic bag *or* mesh bag, fresh vegetable type
2	milk cartons, ½ gal.
1 pkg.	razor blades mounted on cardboard
2 bxs.	toothpaste, deodorant, etc.
1	box, cereal *or* other foodstuff

Preparing to Work

1. Assemble in your regular group.
2. Obtain the different packaged products for your group from your teacher.
3. Each student is to complete the Package Analysis Survey, Fig. 71-1 of the package provided. Evaluate honestly the information you gather about the package.
4. Not all items will apply to the package you are analyzing. Fill in N/A (N/A = Not Applicable) in space provided, if necessary.
5. Read the directions for conducting the survey. Write in the answers and rate each item.

Analyzing the Package

6. When all are finished, analyze and discuss the items listed. Compare individual point ratings.
7. Return the packages to your instructor when finished.

Fig. 71-1. Package Analysis Survey

The following information is usually found on a package. Answer the questions about each category and then rate that category by *circling* a number on a rating scale. The number 1 is low rating. The number 5 is high or excellent rating.

Analysis Group A
Information and Identification

1. Identification of Manufacturer
   a. Give the brand name.
   b. Give the name of the company.
   c. What is the address of the manufacturer?
   d. Sketch the trademark.
   e. What country or origin of manufacture is listed?

RATE CATEGORY NUMBER 1
1 2 3 4 5

2. Identification of Items
   a. What is the product? Describe it.
   b. Is the product a solid, liquid, gas, or combination?
   c. Manufacturer's catalog number.
   d. Serial number.
   e. What color or flavor is it?
   f. Is information provided about ingredients or content of the product?

RATE CATEGORY NUMBER 2
1 2 3 4 5

3. Identification of Quality
   a. Number of units per package.
   b. Net weight or volume.
   c. Is a size of the product stated?

RATE CATEGORY NUMBER 3
1 2 3 4 5

4. Directions for Using
   a. Does the package open as directed?
   b. Are there any hazards involved?
   c. If yes, are they described?
   d. Are there directions for handling or storing the product?
   e. Is there any statement of guarantee or money-back policy?
   f. Is information provided in a foreign language?

Fig. 71-1. Package Analysis Survey (continued)

g. Is there a statement concerning servicing the product?

RATE CATEGORY NUMBER 4
1 2 3 4 5

Analysis Group B
Design of Package

5. Protection
   a. What kind of materials is the package made from?
   b. Is the product protected by insulation to prevent excess damage?
   c. Is the package strong enough to support the product?
   d. Is the package properly insulated for protection from heat or cold?
   e. Does the package have available windows for the consumer to view the contents?
   f. Is there a package within a package?

RATE CATEGORY NUMBER 5
1 2 3 4 5

Analysis Group C
Storage and Other Factors

6. Provisions for Normal Storage and Handling
   a. Does the shape or size of the package affect handling?
   b. Does the design permit stacking?
   c. Could the package have been designed with less volume?
   d. How is the package moved? Does it contain special handles or slots?
   e. How is the product removed from the package?
   f. Can the product be packed into larger units to accommodate storage?
   g. Will the package be transported a long or a short distance?

RATE CATEGORY NUMBER 6
1 2 3 4 5

7. Other Factors
   a. Is it a reusable or a throw-away package?
   b. Will the package be used for display purposes?
   c. If a throw-away, will it inconvenience the consumer as to refuse disposal?
   d. Have you seen the package and product advertised on television, newspaper ads, display boards, etc.?
   e. Does the package have "eye appeal"?
   f. Does the package help you determine which product to buy?

RATE CATEGORY NUMBER 7
1 2 3 4 5

Record the total number of points of the package you have just analyzed.

LABORATORY NOTES

ACTIVITY 72A

Servicing Manufactured Products

Problem 1

Objective

Using names of durable and nondurable goods, work a crossword puzzle.

Crossword Puzzle

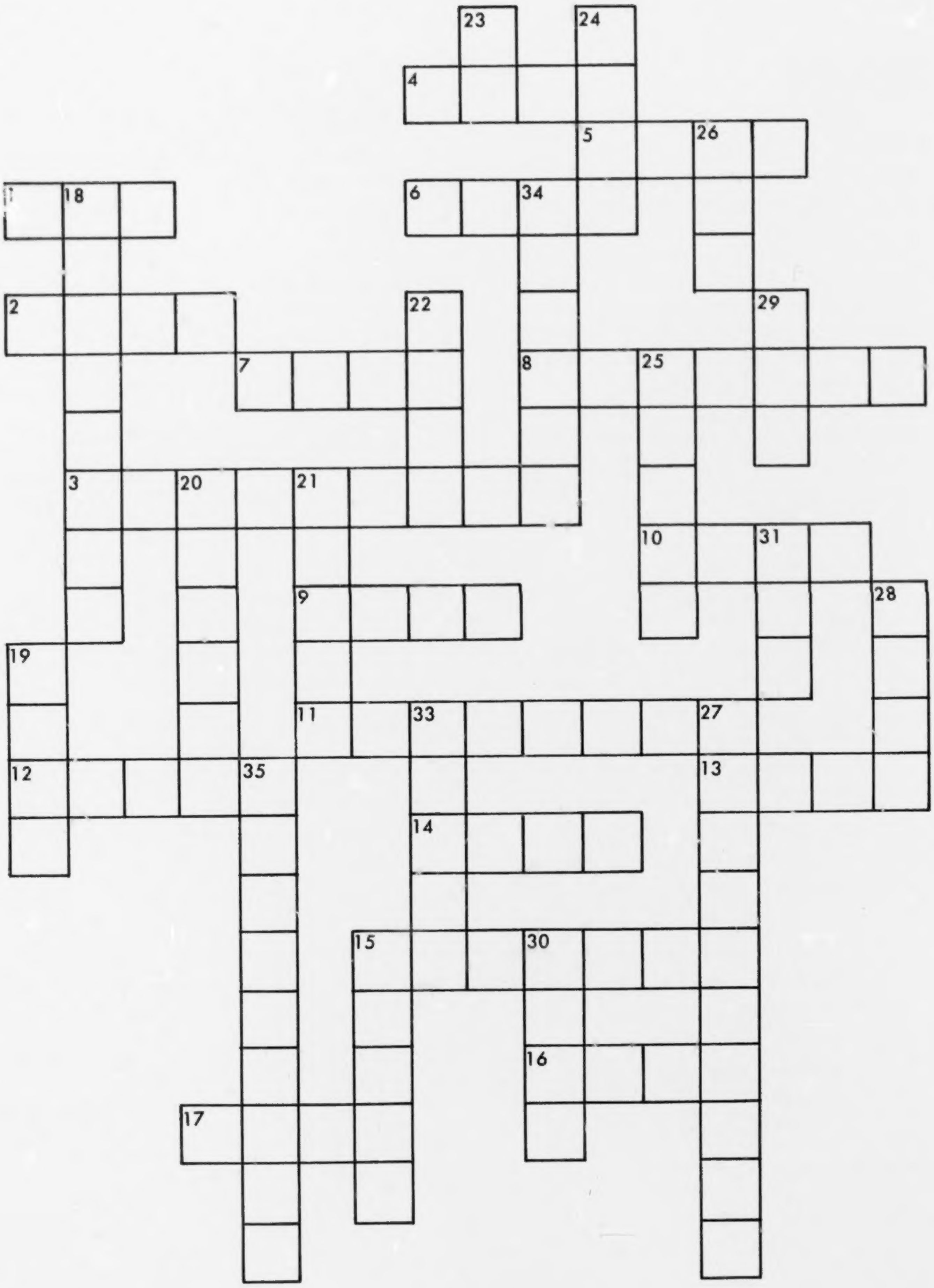
1. For today's activity you will work individually.
2. Complete the puzzle, Fig. 72A-1, by putting in the correct word that best fits the clue given for a durable or nondurable good. See Fig. 72A-2. Each answer is numbered.
3. Use your possible answer list to help you. See Fig. 72A-3.
4. Work as quickly and quietly as possible.

Fig. 72A-3. Possible Answers

horn
soap
oil
battery
car
bulb
pen
transistor
bolt
zinc
tire
yo-yo
rake
aluminum
posters
newspaper
kite
radio
wrench
drum
belt
shoe
light
can
lock
paint
telephone
felt
aircraft
pans
tape
file
toast
lumber
pizza

Fig. 72A-2. Clues for Crossword Puzzle

Durable Goods	Nondurable Goods
Across 1. Passenger ______ 5. Key or combination will open 9. Galvanized coating 11. Jet ______ 12. Flash ______ 13. Yardworking tool 14. Loud band instrument 16. Pots and ______ 17. Electrical device that makes noise	**Across** 2. Fits into light socket 3. Sports section is part of a ______ 4. Mounted on car 6. Buckle is part of a ______ 7. Toy suspended on string 8. 6 or 12 volt 10. Loafers 15. Printed signs
Down 18. Foil used in kitchen 19. Threaded fastener 20. Tool to tighten bolts 24. Heavy cloth material 26. Circular metal container 28. Chip-removing tool, with wood handle 33. AM-FM 34. Used to build houses 35. Answer the ______ 31. Petroleum, lubricates machinery	**Down** 21. ______ pie, cooked in an oven 22. Wash your hands with this 23. Go fly a ______ 25. Heated bread, eaten at breakfast 29. Pencil and ______ 30. Adhesive found in roll form 15. Liquid coating material


23
24
4
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1
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28
19
11
33
27
12
35
13
14
15
30
16
17

Fig. 72A-1. Crossword Puzzle

Problem 2

Objective

Using names of occupations related to servicing manufactured products, work a word puzzle. See Fig. 72A-4.

1. All the words are service occupations. Fig. 72A-5 is a list of service occupations to aid in correct spelling.
2. Use the occupational titles in Fig. 72A-5. Circle the correct answers (27 total occupations) on Fig. 72A-4.
3. The occupations are arranged in up, down, across and diagonal positions.
4. Work as quickly and quietly as possible.

Fig. 72A-5. Occupational Titles

bodyman
bookbinder
brickmason
carpet layer
cobbler
customizer
drapery hanger
dry cleaner
electrician
furrier
glazier
installer
jeweler
mechanic
oiler
optician
painter
paperhanger
plumber
refinisher
repairman
roofer
seamstress
serviceman
tailor
tinner
watchmaker

Fig. 72A-4. Occupation Puzzle

W	A	T	C	H	M	A	K	E	R	A	U	B	T	C	D	V	E	X	W
S	S	T	Z	R	P	Q	Y	N	R	E	F	I	N	I	S	H	E	R	F
E	B	O	D	Y	M	A	N	O	E	L	E	C	T	R	I	C	I	A	N
A	O	R	O	O	F	E	R	H	L	S	R	O	Q	N	N	P	E	R	G
M	O	P	A	I	N	T	E	R	B	L	I	M	P	D	S	A	M	E	I
S	K	G	U	A	V	W	I	U	B	K	F	T	T	R	T	P	O	P	H
T	B	R	I	C	K	M	A	S	O	N	A	I	I	A	A	E	J	A	K
R	I	R	V	S	A	Z	A	Y	C	L	G	C	N	P	L	R	L	I	N
E	N	T	W	U	Q	R	O	I	L	E	R	N	N	E	L	H	N	R	A
S	D	R	O	O	F	B	P	G	L	A	Z	I	E	R	E	A	D	M	M
S	E	L	F	U	R	R	I	E	R	P	M	O	R	Y	R	N	J	A	E
D	R	A	P	E	R	Y	G	C	T	J	K	L	H	H	F	G	E	N	C
P	L	U	M	B	E	R	T	A	I	L	O	R	I	A	D	E	W	E	I
C	I	N	A	H	C	E	M	S	U	T	A	I	V	N	W	R	E	X	V
A	B	C	O	P	T	I	C	I	A	N	A	Y	B	G	C	E	L	Y	R
D	R	Y	C	L	E	A	N	E	R	M	R	N	E	E	Q	R	E	P	E
D	F	G	H	E	C	U	S	T	O	M	I	Z	E	R	U	K	R	L	S

ACTIVITY 72B

Servicing Manufactured Products

Today you will diagnose and repair a manufactured product.

Problem

Objective

Using the necessary equipment and supplies, troubleshoot an electric circuit and diagnose the malfunction.

Equipment (Group of 2)

1	continuity tester
1	circuit board

Equipment (Class)

1	vacuum tube voltmeter *or* volt-ohmmeter

Preparing to Work

1. Assemble with your partner and obtain your supplies and equipment.

> **Safety**
>
> Continuity tester is to be used only on circuit boards. It was not designed for electrical circuits other than *low voltage* batteries.

2. Following the troubleshooting checklist, Fig. 72B-1, diagnose the malfunction and make any necessary repairs. It is important that you follow the troubleshooting checklist.
3. Refer to this list of possible malfunctions as you go through the checklist.
   a. dead battery
   b. weak battery
   c. burned-out bulb
   d. faulty switch
   e. break in circuit
   f. high resistance connections—loose wires
4. If you locate a malfunction, make the necessary repairs, then continue following the checklist. There may be more than one malfunction.
5. When you have completed the troubleshooting checklist, prepare the circuit

Fig. 72B-1. Troubleshooting Checklist

Procedure for Diagnosing Malfunction	Check Malfunction	
	OK	Repair
1. Check Battery Voltage		
2. Check Bulb Continuity		
3. Check Switch Continuity		
4. Check Wire A-B Continuity (See Fig. 78B–2)		
5. Check Wire C-D Continuity (See Fig. 78B–2)		
6. Check Wire E-F Continuity (See Fig. 78B–2)		
7. Check All Connections		

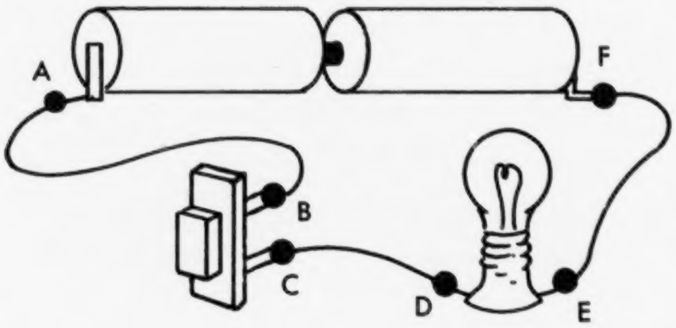


Fig. 72B-2. Diagram of Circuit Board

board for the next class. Without damaging the board or any of the components, set up some malfunction for the next class to locate and repair. You might install a burned-out bulb, a weak battery, or make some loose or incomplete connections.

6. Answer the questions. Return all equipment and supplies and clean up your work area.

Questions

1. Before a malfunctioning product can be repaired, the malfunction must be

   lo______________ .

2. In locating a malfunction, the serviceman usually follows a

   tr____________________ checklist.

ACTIVITY 73A

Story of Printed Products

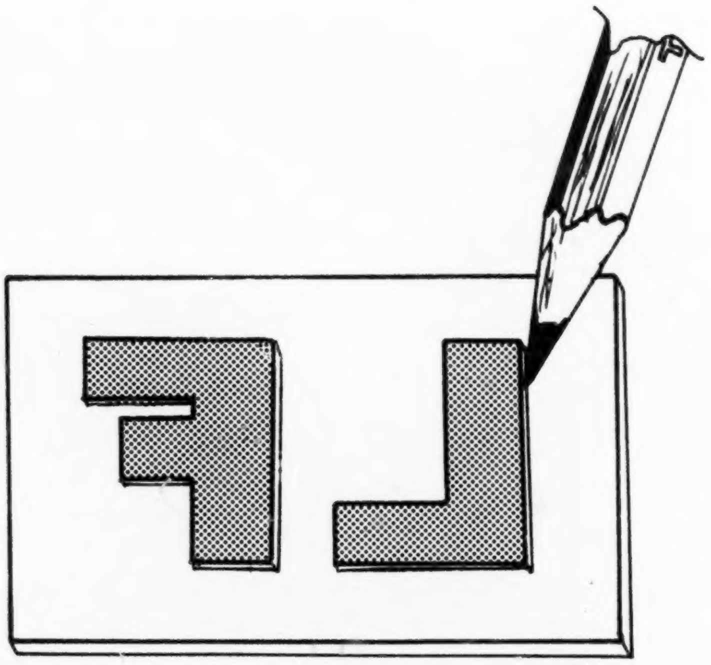


Fig. 73A-1. Outlining Cardboard Letters on Rubber

Today your group will make a personalized note pad. Relief printing (one of four basic types of printing) will be used. The pads represent a commercial printing product.

Problem 1

Objective

Using the proper equipment and supplies, design, cut out, and assemble a relief stamp.

Equipment (Group of 5)

2	12″ rules
3 pr.	scissors *or* X-acto® knives
2	ballpoint pens

Supplies (Group of 5)

5 pcs.	8½″ x 11″ plain paper
5 pcs.	1″ x 2″ inner tube *or* gasket rubber
5 pcs.	½″ x 1½″ x 2½″ wood
1 btl.	rubber cement with brush in cap

Preparing to Work

1. Get the necessary equipment and supplies.
2. Using 1″ cardboard letters, outline the letters onto the piece of material given to you by your teacher. See Fig. 73A-1.
3. Carefully cut the letters out with a pair of scissors or an X-acto® knife. See Fig. 73A-2.
4. Transfer the letters (in reversed order) to the block of wood. See Fig. 73A-3.
5. Coat the back of the rubber initials with rubber cement and attach them to the block of wood. See Fig. 73A-4.

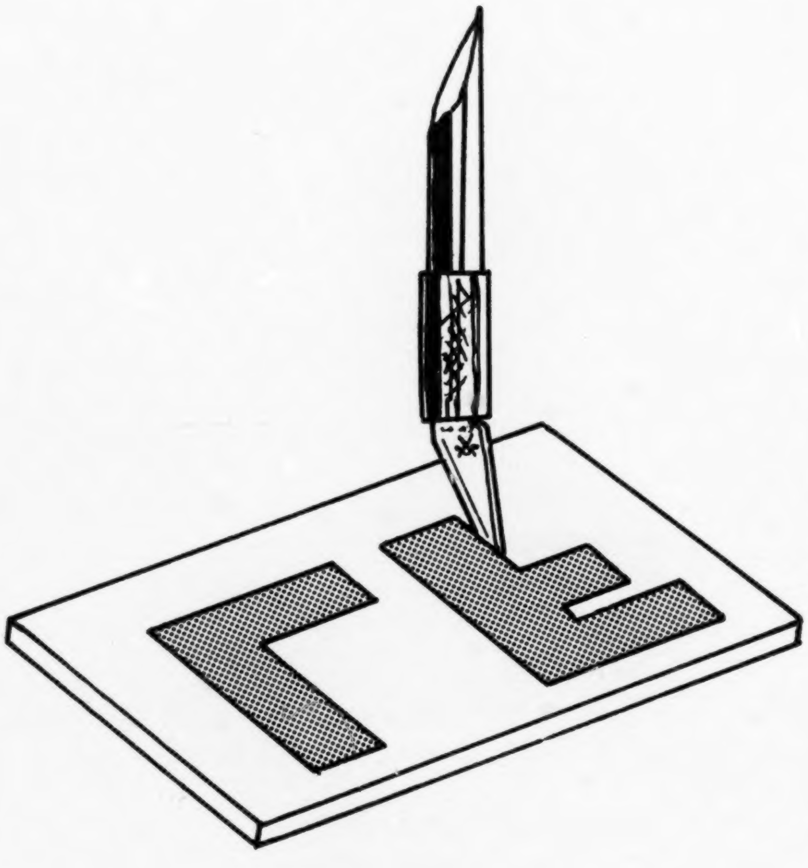


Fig. 73A-2. Cutting Out Rubber Letters

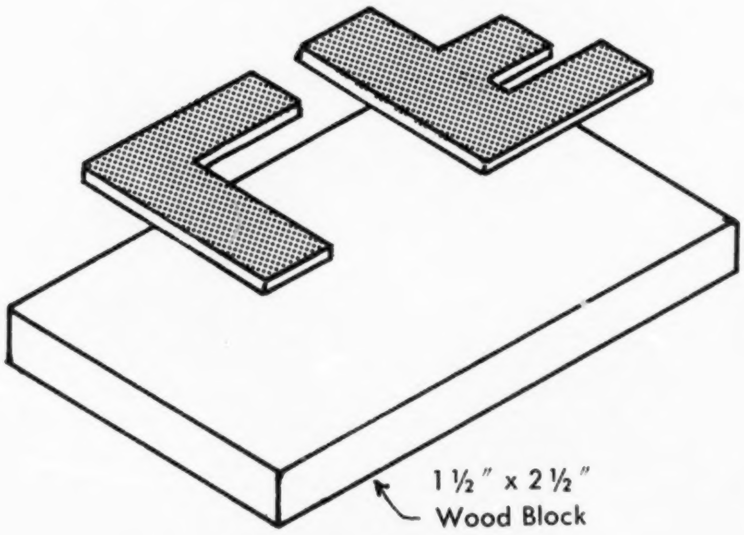


Fig. 73A-3. Transferring Letters

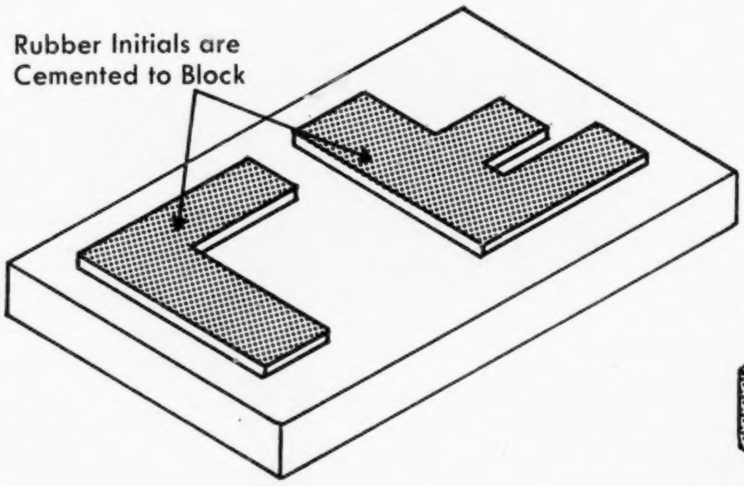


Fig. 73A-4. Rubber Letters Mounted to Wood Block

Problem 2

Objective

Using the rubber stamp, print the pages of a note pad and assemble them.

Equipment (Group of 5)

1	10" C-clamp, optional
1	rubber stamp pad
1	padding brush

Supplies (Group of 5)

50	3" x 5" white cards
2 pcs.	4" x 6" scrap wood
6 pcs.	3" x 5" chipboard
1	newspaper to cover table
1 pt.	paddling cement

Printing

1. Cover the bench with newspaper.
2. Print ten copies of your design. See Fig. 73A-5.
3. Lay the prints aside to dry. Do not stack them.
4. After the prints are dry, submit one copy to your teacher for proofreading.
5. Stack your cards. Be sure that your initials are right side up.
6. Place a 3" x 5" piece of chipboard, cardboard, underneath the stack you have made. See Fig. 73A-6.
7. All students in the group will then place their stacks of cards together to form one stack.

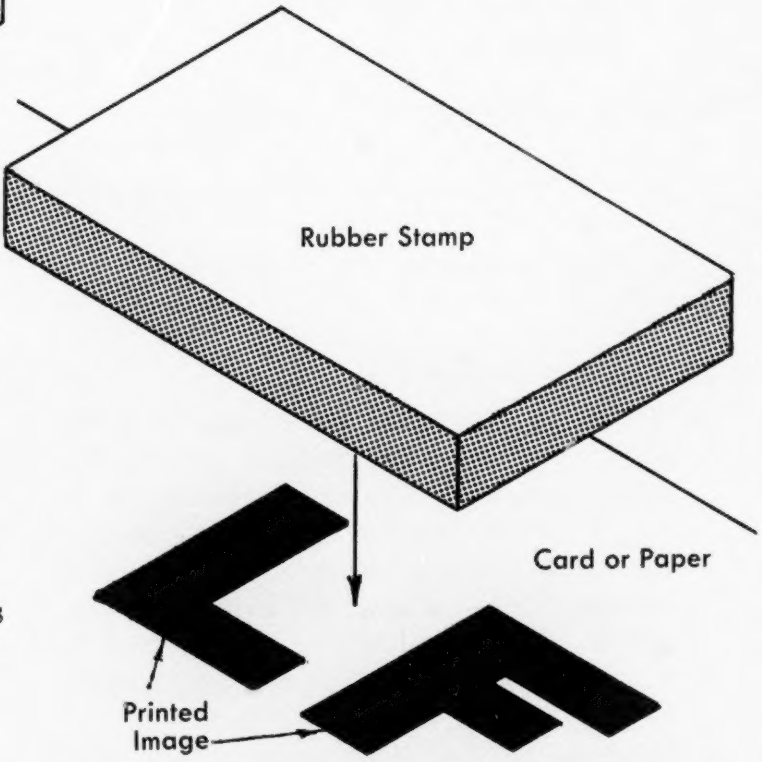


Fig. 73A-5. Printing the Rubber Stamp

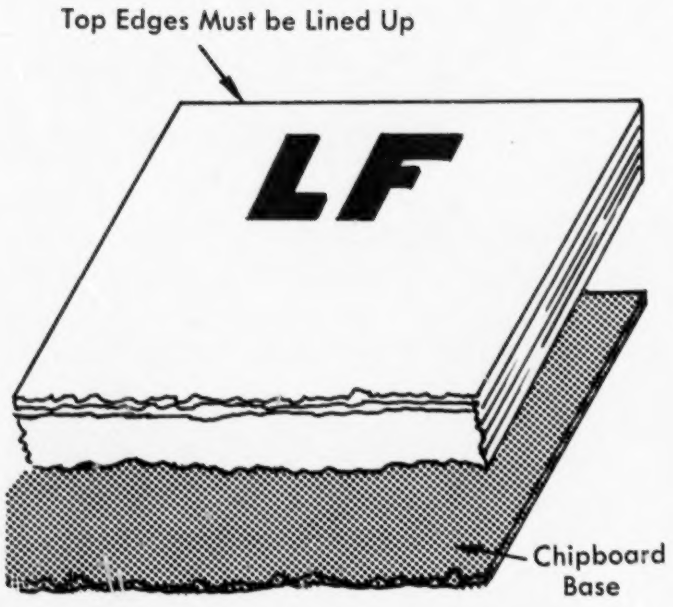


Fig. 73A-6. Stacking the Pads

8. Place a 3" x 5" piece of chipboard on the top of the stack.

Padding

9. Carefully sandwich the stack between two pieces of wood and clamp it firmly in the vise; expose about ½" of the top edge above the vise jaws. See Fig. 73A-7.
10. The foreman of each group will brush on the *padding cement*. Brush from center to outer edge, to prevent drying along sides of stack.
11. Let the padding cement dry thoroughly. If the pads are not dry by the end of the period, the teacher will return your pads at the next class period.
12. Wash the padding brush thoroughly in water, and return all equipment and supplies to their proper areas.

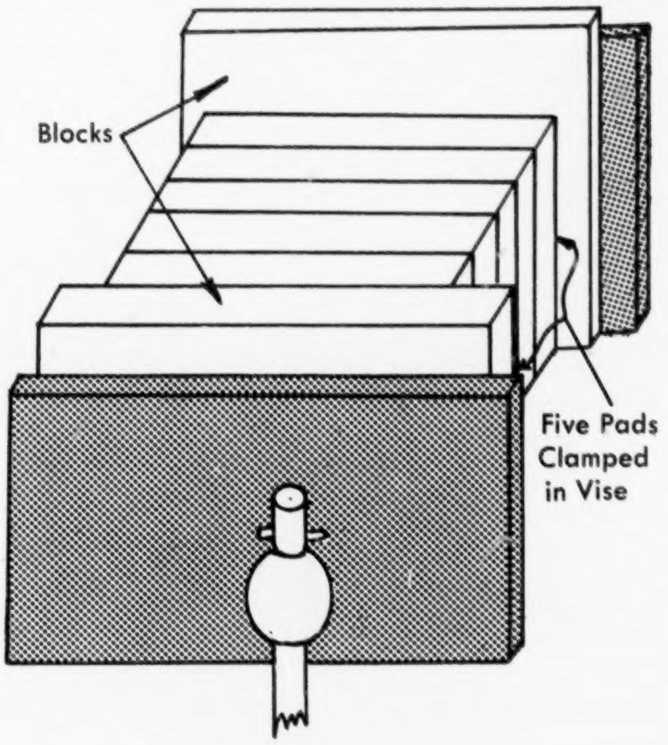


Fig. 73A-7. Preparing the Pads for Padding

Questions

1. Which major type of printed product did you make?

   ____

2. What basic type of printing *process* did you use to make the note pad?

   ____

3. What binding material was used to hold the pages of your note pad together?

   ____

ACTIVITY 73B

Story of Printed Products

Today you will manufacture an autograph book. All groups will prepare printing masters. Then each group will perform a different operation: printing, folding, collating, binding, or trimming.

Problem

Objective

Using the proper equipment and supplies, print, fold, collate (assemble), bind, and trim a multipage autograph book.

Equipment (Class)

1	spirit duplicating machine
5 pr.	scissors (5″)
5	12″ rules
1	stapler (5″ throat or larger)
1	15″ paper cutter

Supplies (Class)

1 jar	hand cleaner for removing spirit duplicating ink
1 can	spirit duplicating fluid
100 shts.	8½″ x 11″ duplicator paper
6	spirit masters

Caution

a. The purple dye on spirit duplicating masters is *very* hard to remove from some clothing, and a small amount of the dye can spread over a large area. Drop the carbon sheet into a waste container at once, after the master is prepared.

b. If you get some of the dye on your fingers, clean it off with the special hand cleaner so it will not spread.

All Groups Preparing to Work

1. Meet with your group of five students. The foreman will direct the activity.
2. Obtain a spirit duplicating master and rule.

Preparing a Master

3. Leave the thin sheet *in* the master. Lightly draw two lines to divide the master into four equal rectangles. See Fig. 73B-1.
4. Remove the thin separator sheet from between the master sheet (white) and the carbon sheet (purple or brown).
5. Sign your name in one of the four spaces. *Make sure your name is placed correctly.* The fifth student can sign his name in the same area as the fourth student. See Fig. 73B-2.
6. Your teacher will now assign your group one of five operations. Find and follow the directions for your assignment.

Group 1
Printing

7. The teacher will show the foreman how to operate the duplicating machine. Other group members will assist him.

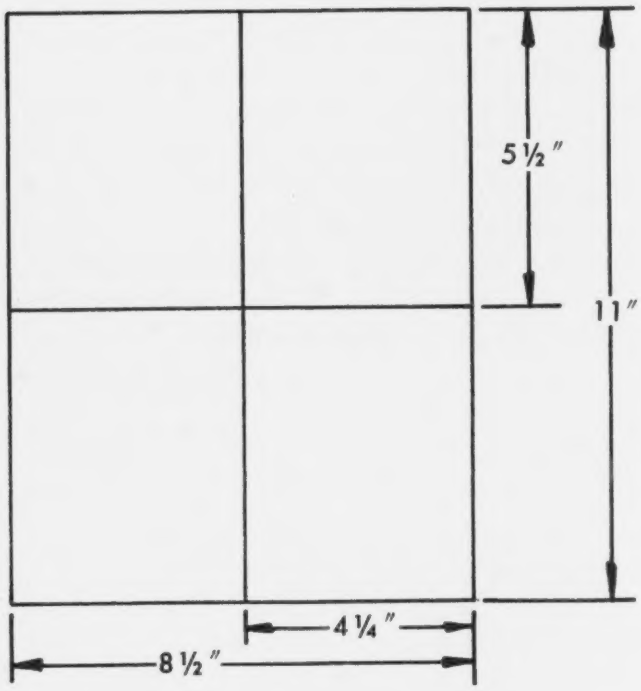


Fig. 73B-1. Proper Layout of the Ditto Master

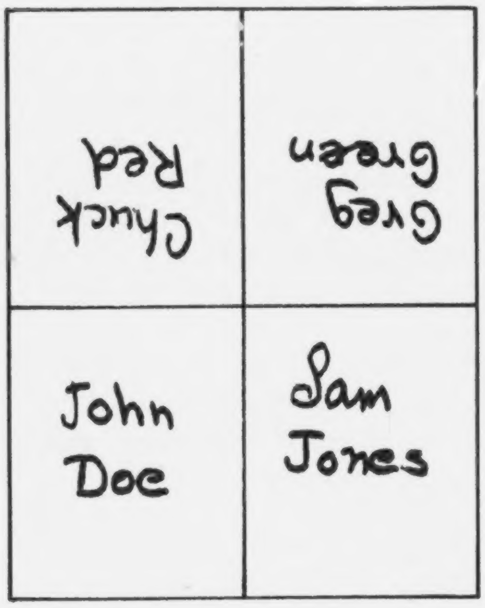


Fig. 73B-2. Ditto Showing Proper Name Layout

8. The pages of the autograph book are to be "backed"—printed on both sides. Plan on producing enough copies so each class member and the teacher can have one.
9. Print the copies from your first master. Stack them carefully and turn the stack over so the sheets can be printed on the reverse side.
10. Print the copies from your second master. Stack them and pass the stack to Group 2.
11. As each pair of masters is copied, pass the printed sheets on to Group 2. The last master you print from should be the cover, which your teacher has prepared.
12. All group members should clean their hands thoroughly. Be sure that the work area is thoroughly cleaned.

Group 2
Folding

13. Your group will receive the printed pages from Group 1. Each group member has a different task:

First man

Take sheets from the stack *one at a time*. Check to see that each sheet is printed properly on both sides.

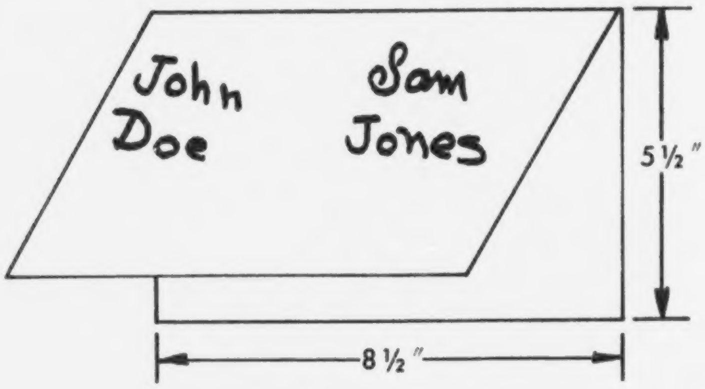


Fig. 73B-3. Fold the Sheet Carefully, One Sheet at a Time

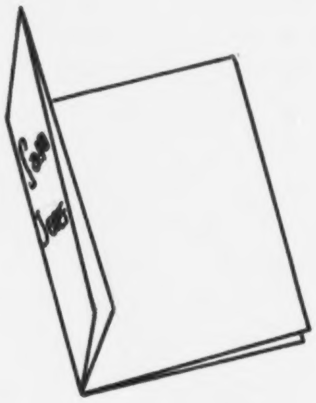


Fig. 73B-4. Make the Second Fold, Again Using Care

Second man

Fold each sheet as in Fig. 73B-3. Make a good, even fold.

Third man

Fold each sheet again, so that your fold is at the top of page. Make a good fold. See Fig. 73B-4.

Fourth man

Check and stack each folded sheet. This four-page booklet is called a *signature*. Pass the signatures on to Group 3.

Group 3
Assembling

14. Stack the copies of each separately. Set the stacks in a row with the *cover* signature at one end of the row.
15. All four group members should walk around the stacks of signatures, picking up one sheet from each stack and col-

lating (assembling) them as in Fig. 73B-5.

16. Repeat until all the sets of signatures are assembled.
17. Pass the assembled booklets on to Group 4.

Group 4
Binding

18. Each member of your group has a different task:

First man

Pick up the assembled booklets, one at a time.

Second man

Align all the signatures in one booklet. Then open the booklet and fit it into the stapler so that the staples are *folded over* on the *inside* of the booklet. See Fig. 73B-6.

Third man

Hold the booklet so that it will be stapled as shown in Fig. 73B-7.

Fourth man

Drive two staples into each booklet and pass it on to Group 5.

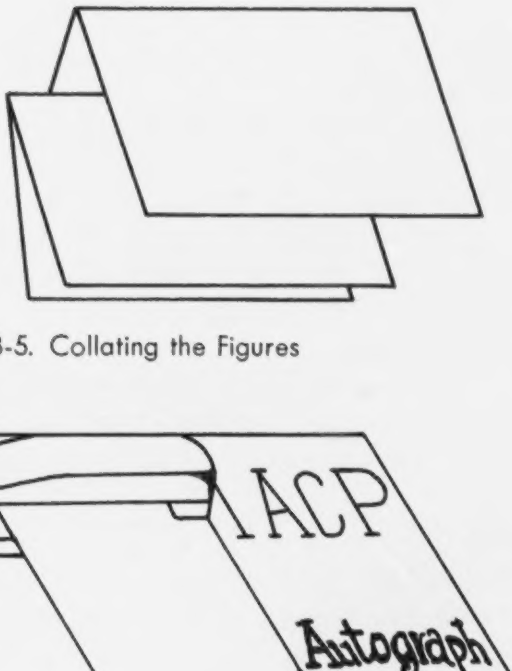


Fig. 73B-5. Collating the Figures

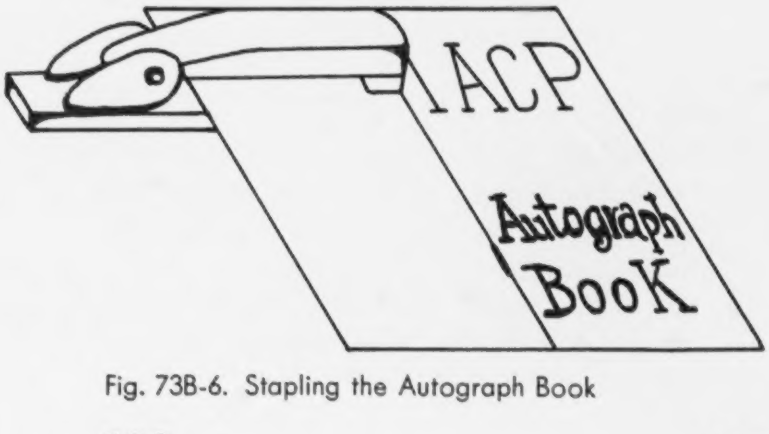


Fig. 73B-6. Stapling the Autograph Book

Group 5
Trimming

19. All the members of your group should trim book pages. Slip a scissor blade into the top fold of one book and cut through all the sheets neatly.
20. If time and equipment permit, you may trim the booklets to a uniform size.
21. Distribute the booklets to the class when the teacher tells you to do so.

Cleaning Up

22. All groups are to help clean up the laboratory. Return equipment and supplies to their proper storage area.

Questions

1. In bookmaking, one large printed sheet, before it is cut, is called a

s ________________.

2. After you prepared the masters for your autograph book, what five operations were performed? (List them in order.)

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

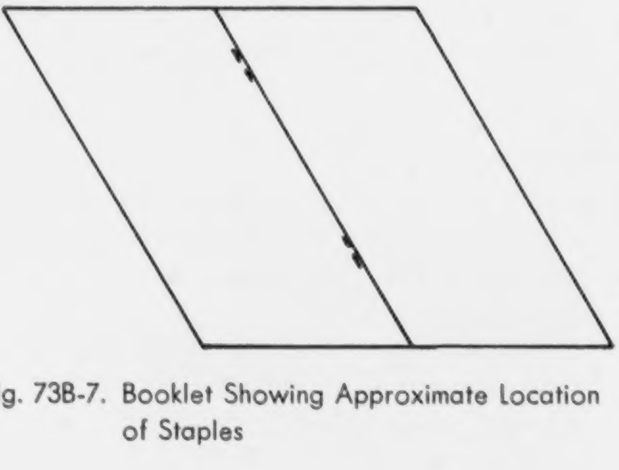


Fig. 73B-7. Booklet Showing Approximate Location of Staples

ACTIVITY 74

The Manufacturing Corporation

Problem

Objective

Using information from the slides and Laboratory Manual figures:

- a. Identify some advantages and disadvantages of corporations.
- b. Name three corporations and identify their trademarks.

1. Your teacher showed you a transparency listing the characteristics of a corporation. Fig. 74-1 shows these characteristics.

Identifying Advantages and Disadvantages

2. Read Fig. 74-1. Some items are *advantages* or benefits. Some items are *disadvantages.* Read each item and check either the "Advantage" column or the "Disadvantage" column as shown in examples 1 to 4.
3. Some items may be both an advantage *and* a disadvantage, depending on who you are. For example, taxes help build good schools, so high taxes are an advantage for students and their parents.
4. Your teacher will review the list when you are through.

Identifying Trademarks

5. See Fig. 74-2, Corporations and Their Trademarks, and write any three of the corporation names you saw in the slides of corporations. Put beside them the trademarks for those corporations. See example in Fig. 74-2.

Fig. 74-1. Advantages and Disadvantages of Corporations

Characteristics	Advantage	Disadvantage
1. Corporations tend to reduce competition. (Consumer's view)		✓
2. Corporations are flexible.	✓	
3. Corporations are expensive and inconvenient to form.		✓
4. Corporations have limited liability.		✓
5. Periodic reports are required. (Consumer's view)		
6. The law recognizes corporations as entities.		
7. Loans are hard for small corporations to obtain		
8. Corporations may pay higher taxes than other companies.		
9. Large-scale production is easy.		
10. Corporations can raise funds by selling stock.		
11. Stockholders have a say in the management of the corporation.		
12. Corporations grow and expand easily.		
13. Corporations are run under rules and regulations. (Consumer's view)		
14. Corporations have longevity.		
15. Corporations can attract capable managers.		

Fig. 74-2. Corporations and Their Trademarks

Corporation Name	Identifying Trademark
Example WESTINGHOUSE CORPORATION	W
1.	
2.	
3.	

6. NOTE: In tomorrow's activity you will be asked to select a name and trademark for your lamp corporation. Recall the slides you have just seen as you think of names and trademarks.

Questions

1. The word which means that a corporation exists *separate* and *apart* from its organizers is

"ent____________."

2. The document that lists the corporate *name* and describes its purposes is called

the cha________.

3. A type of corporation in which the owners can be *held responsible* for corporation debts is called a

jo____st__________company.

4. A *charter* to establish a corporation is issued by which level of government (federal, state or local)?

____

5. The persons who eventually make the corporation successful are the

cu____________.

6. A corporation is normally chartered for a definite length of time, like 10 years.

______ True ______ False

7. Limited liability of a corporation means that its officers and stockholders cannot be held legally responsible for things done in the name of the corporation.

______ True ______ False

8. A corporation can *expand* its operations through the sale of *stocks* and *bonds*.

______ True ______ False

ACTIVITY 75A

Forming a Corporation

Today we will select a name for our corporation.

Problem

Objective

Using two examples of corporation names, "Magic Lamp Company" and "Mantec" (*Man*ufacturing *tech*nology), each group will suggest several names and select one to compete for a corporation name for the class.

Supplies (Group of 5)
5 shts. 8½″ x 11″ paper

Selecting a Name for the Corporation

1. Write three names you think might be appropriate for our corporation. Be ready to read these names when called for by the foreman.
2. Your foreman should conduct a survey in your group to select a name by tally of raised hands when he reads the corporation names. The first time the names are read you should think about which one is best. The second time a count of hands should be tallied when the names are read. This will be the name selected by the group for the class to vote on.
3. The teacher will ask for the winning name in each group and write the name on the chalkboard.
4. The class will vote by a show of hands to select the best name written on the chalkboard. The foreman (selected by the teacher) will count the show of hands as each name is called. He will then give the teacher the final count when the teacher requests this information.

ACTIVITY 75B

Forming a Corporation

Today you will obtain a charter. Members of the class will serve as officials and complete the needed forms.

You will also design a trademark. NOTE: The procedures you will follow in forming a corporation may be different in some states.

Problem 1

Objective

Using the requirements for forming a corporation:

a. Elect three board members.
b. Name the corporation.
c. Select an agent.
d. Fill out the forms to obtain a charter.
e. Design a trademark.

Selecting Board Members

1. By voting, select three board members to handle the incorporating procedures.
2. The Governor of a state usually appoints his Secretary of State. The teacher will appoint someone to fill this position in your class.

Naming the Corporation

3. Select a name for your corporation. Two examples are given; you should suggest two or three more and select one of them by class vote. Place your suggestions on the lines below Example 2.

Example 1: "Magic Lamp Company"
Example 2: "MANTEC" (*Man*ufacturing *Tec*hnology)

____

____

____

Selecting an Address

4. Select an address for your corporation. You might choose your school address, or office building in the business district of your city, or a major city (other than your own).

Making Contact with State Government

5. The Chairman of the Board (elected by the board members) will make an appointment or call the Secretary of State. During the discussion, he will ask about the procedure for establishing a corporation. A telephone conversation might sound something like this:
(Read the lines or rephrase them.)

Chairman of the Board
"Mr. Secretary of State, I am Sam Jones."

Secretary of State
"How do you do, sir. Is there something I could help you with?"

Chairman
"I would like to inquire about the procedure for obtaining a charter for a corporation."

Secretary of State
"Do you have a name selected?"

Chairman
"Yes. It will be called

________________________________."

Secretary

"I assume that the legal address of your proposed corporation will be in this state?"

Chairman

"Yes, the address will be

____________________________________."

Secretary of State

"Fine. There are two forms to complete. I will send them to you. It is very important that all information be complete and accurate. Fill them out and return them to me for my signature."

Chairman

"Thank you. We will get them properly filled out and return them to you as soon as possible."

Problem 2

Objective

Using Fig. 75B-1, the "Original Appointment of Agent" form, appoint an agent and complete the form.

NOTE: Each student will complete his own copy. There will be one completed copy posted for each class.

Completing "Appointment of Agent"

1. The three incorporators elected in Problem 1 should select a student to serve as an agent of the incorporating company. This agent will assume the role of the corporation president in later lessons.
2. On Fig. 75B-1 enter the corporation's name on each blank numbered (1).
3. Enter the agent's name on the blank numbered (2).
4. Enter the complete corporation address selected in Problem 1 on the blank numbered (3).
5. Enter the city and state of incorporation on the blanks numbered (4).
6. Enter today's date on the blank numbered (5).
7. Enter the name of the board members selected in Problem 1 on the blanks numbered (6) . . . one name on each line.
8. Enter the name of the agent selected in Step 1 of this problem on the blank numbered (7). He is to sign only the posted copy.
9. Enter the name and title of the Chairman of the Board, selected in Problem 1 on the blank numbered (8). The Chairman of the Board will sign only the posted copy.

Problem 3

Objective

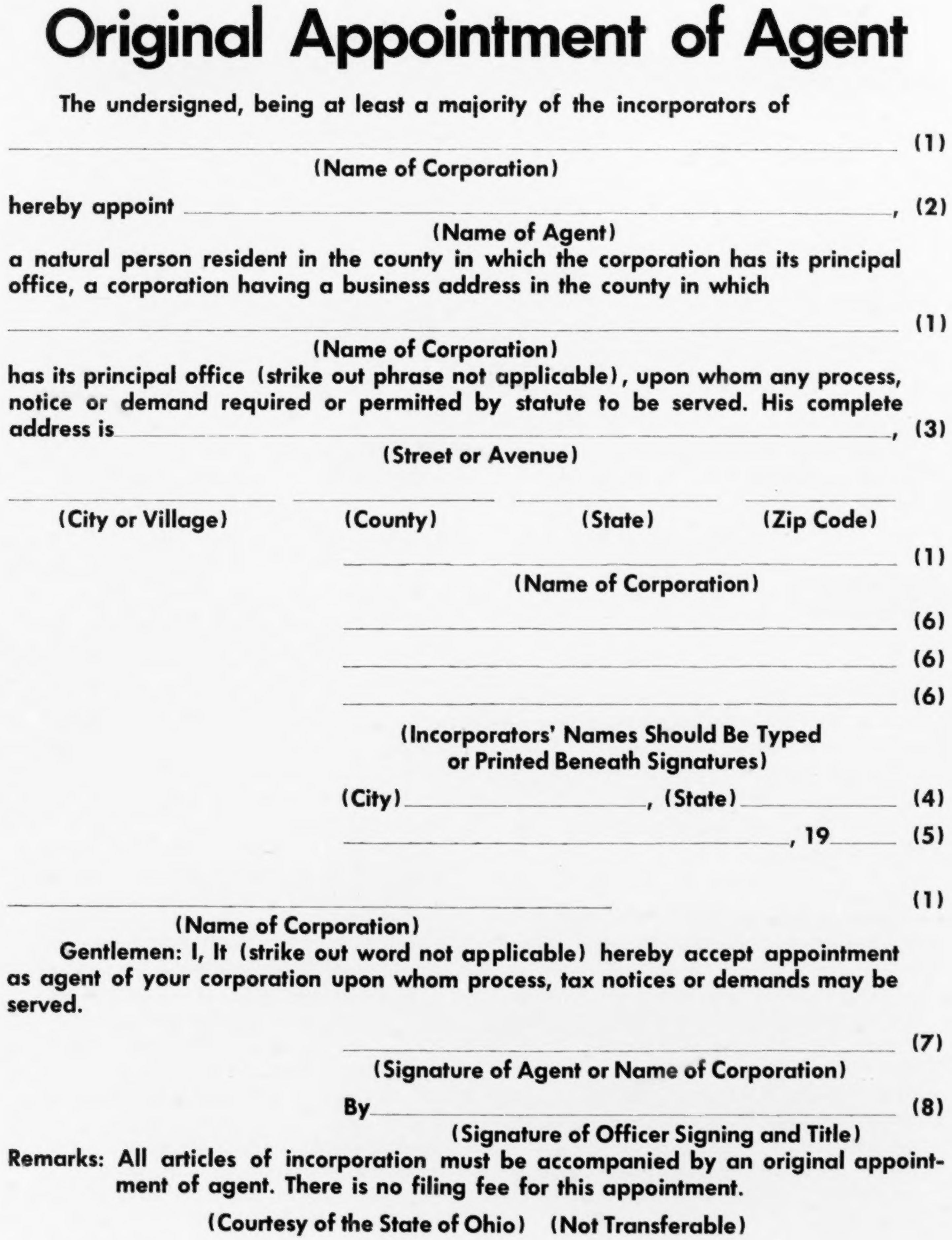
Using Fig. 75B-2, "Articles of Incorporation," complete the form.

NOTE: Each student will complete his own copy. There will be one completed copy posted for each class.

Completing "Articles of Incorporation"

1. On Fig. 75B-2 enter the corporation name on each blank numbered (1).
2. Enter the corporation address on the blank numbered (2).
3. Prepare a Statement of Purpose. Decide upon this as a group, and enter it on the blank numbered (3). Your purpose might be to produce lamps of a particular style or type.
4. The FOURTH article is the same number as the class enrollment in manufacturing. Ask your teacher for this number.
5. Multiply the number in Step 4 by $1.00 to get the dollar value for the FIFTH article.
6. Fill in the date on the blank numbered (6).
7. Enter the name of each board member on the blank numbered (7) . . . one name on each line. Board members should each sign the posted copy.

Fig. 75B-1



Original Appointment of Agent

The undersigned, being at least a majority of the incorporators of

____ (1)
(Name of Corporation)

hereby appoint ______________________________________, (2)
(Name of Agent)

a natural person resident in the county in which the corporation has its principal office, a corporation having a business address in the county in which

____ (1)
(Name of Corporation)

has its principal office (strike out phrase not applicable), upon whom any process, notice or demand required or permitted by statute to be served. His complete address is ______________________________________, (3)
(Street or Avenue)

____________	____________	____________	____________
(City or Village)	(County)	(State)	(Zip Code)

______________________________ (1)
(Name of Corporation)

______________________________ (6)
______________________________ (6)
______________________________ (6)

(Incorporators' Names Should Be Typed
or Printed Beneath Signatures)

(City) ______________, (State) ______________ (4)
______________________, 19______ (5)

______________________________ (1)
(Name of Corporation)

Gentlemen: I, It (strike out word not applicable) hereby accept appointment as agent of your corporation upon whom process, tax notices or demands may be served.

______________________________ (7)
(Signature of Agent or Name of Corporation)

By ______________________________ (8)
(Signature of Officer Signing and Title)

Remarks: All articles of incorporation must be accompanied by an original appointment of agent. There is no filing fee for this appointment.

(Courtesy of the State of Ohio) (Not Transferable)

Fig. 75B-2

Articles of Incorporation

— OF —

APPROVED FOR FILING

By ____________________

Date ____________________

Amount ____________________

(1) ____

(Name of Corporation)

The undersigned, a majority of whom are citizens of the United States, desiring to form a corporation, for profit, under Sections 1701.01 et seq. of the Revised Code of Ohio, do hereby certify:

FIRST. The name of said corporation shall be (1) ____

____

SECOND. The place where its principal office is to be located

(2) ____________________ ____________________

(City or Village) (State)

THIRD. The purposes for which it is formed are:

(3) ____

____

____

FOURTH. The number of shares which the corporation is authorized to have outstanding is (4) ____

____

FIFTH. The amount of stated capital with which the corporation shall begin business is (5) ____________________ Dollars ($__________).

IN WITNESS WHEREOF, We have hereunto subscribed our names, this (6) ______ day of ____________, 19____.

(1) ____

(Name of Corporation)

(7) ____

(7) ____

(7) ____

(INCORPORATORS' NAMES SHOULD BE TYPED OR PRINTED BENEATH SIGNATURES)

N. B. Articles will be returned unless accompanied by form designating statutory agent. See Section 1701.07, Revised Code of Ohio.

(Courtesy of the State of Ohio) (Not Negotiable)

8. The Secretary of State will assign a charter number, which will be placed in the upper righthand corner, and the state seal will be affixed.

Problem 4

Objective

Using ideas gained from the slides of corporation trademarks, design a trademark for the lamp corporation.

Supplies (Class)

1	State Seal

Supplies (Group of 5)

5 shts. 8½" x 11" sheet of paper

Designing a Trademark

1. On one side of an 8½" x 11" sheet of paper rapidly sketch three different designs of trademarks that might be used for the lamp corporation.
2. Select the best design to make a refined sketch on the reverse side of the paper.
3. Place your design by other designs in your group to select the best design by group vote.
4. The group foreman should deliver the best design to the teacher.

ACTIVITY 76

Locating the Plant and Securing Inputs

All corporations, including yours, need capital to begin production of a product. Today, stocks will be issued and sold to secure one of the necessary inputs to manufacturing, capital.

Problem 1

Objective

Using the problem of obtaining capital for running a corporation:

a. Calculate the number of stock shares to be sold.
b. Sell stock and complete a stock certificate.

Supplies (Class)

25 stock certificates

Calculating Stock Sale Needs

1. Assume that the money the corporation needs to begin production is $81.00. (This is determined later in ACTIVITY 77.) Use this figure now to find out how many shares of stock must be sold, at $1.00 each. Divide the money needed by $1.00.

$1.00) $ ________

2. The number of shares to be sold at $1.00 per share is ____________ .

Completing Articles of Incorporation

3. In the charter, *Articles of Incorporation,* (ACTIVITY 75B) under "FOURTH," record the number of shares to be sold. See Step 2 above.
4. On the same form, under "FIFTH," record the amount of money needed. See Step 1 above.
5. The state charges a fee when a charter is filed. It is based on the number of shares authorized for distribution by the charter (Articles of Incorporation). The minimum (the smallest fee) is $10.00. NOTE: For 400 shares or fewer, charge to the corporation the minimum fee of $10.00.
6. For filing its charter, your corporation will be charged a fee of

   $ __________ . This amount is submitted to the state, along with the charter (Articles of Incorporation) and the Original Appointment of Agent.

Selling Stock

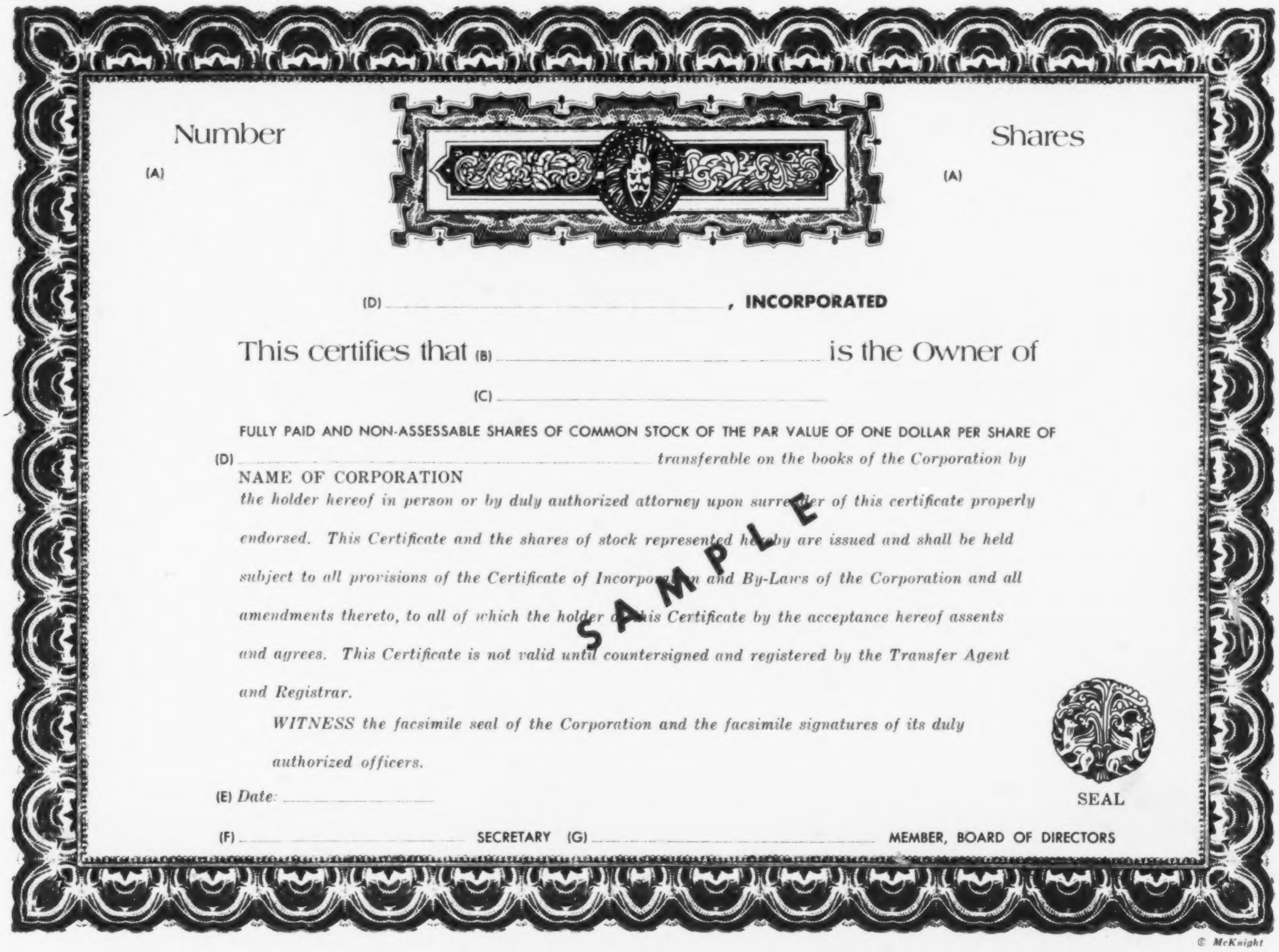
7. Your teacher will distribute stock certificates (as shown in Fig. 76-1) among members of your class. Then he will choose four or five students to play the following roles:

   Stockbroker—Sells stock to individuals.

   Clerk (1 or 2)—Prints data on stock certificates. Two clerks are needed in large classes.

   Treasurer—Collects money for stock bought.

   Chairman of the Board of Directors.
8. Decide how many shares of stock you wish to purchase. This may be divided evenly among the class members if you elect to do it this way.



Number

(A)

Shares

(A)

(D) ______________________, **INCORPORATED**

This certifies that (B) ______________________ is the Owner of

(C) ______________________

FULLY PAID AND NON-ASSESSABLE SHARES OF COMMON STOCK OF THE PAR VALUE OF ONE DOLLAR PER SHARE OF

(D) ______________________ *transferable on the books of the Corporation by*

NAME OF CORPORATION

the holder hereof in person or by duly authorized attorney upon surrender of this certificate properly endorsed. This Certificate and the shares of stock represented hereby are issued and shall be held subject to all provisions of the Certificate of Incorporation and By-Laws of the Corporation and all amendments thereto, to all of which the holder of this Certificate by the acceptance hereof assents and agrees. This Certificate is not valid until countersigned and registered by the Transfer Agent and Registrar.

WITNESS the facsimile seal of the Corporation and the facsimile signatures of its duly authorized officers.

(E) *Date:* ______________

SEAL

(F) ______________ SECRETARY (G) ______________ MEMBER, BOARD OF DIRECTORS

SAMPLE

© McKnight

Fig. 76-1. Stock Certificate

The following abbreviations, when used in the inscription on the face of this certificate, shall be construed as though they were written out in full according to applicable laws or regulations:

TEN COM — as tenants in common
TEN ENT — as tenants by the entireties
JT TEN — as joint tenants with right of survivorship and not as tenants in common

UNIT GIFT ______ Custodian ______
MIN ACT (Cust.) (Minor)
under Uniform Gifts to Minors
Act ______
(State)

Additional abbreviations may also be used though not in the above list.

☐ Social Security or identifying number of assignee

For value received, ______ *hereby sell, assign and transfer unto* ______

______ print name and address of assignee ______

______

______

______

______ *Shares*

of the capital stock represented by the within Certificate, and do hereby irrevocably constitute and appoint ______

______

Attorney to transfer the said stock on the books of the within-named Corporation with full power of substitution in the premises.

Dated, ______

Fig. 76-1.
Stock Certificate
(Back Side)

9. The *clerk(s)* will print on each student's stock certificate(s) the following information:
   a. The number of shares the student desires—in the upper left-hand *and* right-hand corner, at (A), as shown in Fig. 76-1.
   b. The student's name, (B).
   c. Under the student's name, (C), the number of shares of stock spelled out, such as "four," etc. (Do not use the figure "4").
   d. The name of the corporation (D) (two places).
   e. The date, (E).
10. The *stockbroker* will sign at (F) before the word "SECRETARY."
11. A *member* of the *board of directors* signs at (G), before the phrase "MEMBER, Board of Directors."
12. *Each* student will retain his own stock certificate(s) *in* his Laboratory Manual. The teacher may assign additional certificates.
13. The reverse side of the stock certificate is to be left *blank*. It is to be used *only* if stock is *sold* or *transferred* to another company or individual.

ACTIVITY 77

Relating People to the Corporation

Problem 1

Objective

Using the information on Fig. 77-1, fill in a Line Organization Chart (Chain of Command) with names of students as they are selected for the jobs listed.

Placing People in the Corporation

1. The incorporators acting as a board of directors, and the agent acting as president of the corporation will appoint students to the available management positions.
2. The board of directors and the corporation president will go to the front of the classroom and name the students they decide would best qualify for each of the vice-president positions. All students will fill in the Organization Chart (Fig. 77-1) with the names of the vice-presidents as they are announced.
3. The president of the corporation will select students to fill the remaining positions. All students write the names of employees on the chart as students are selected. See Fig. 77-1.

Problem 2

Objective

Using the Organization Chart (Fig. 77-1) as a directive, fill out an Employment Application (Fig. 77-2) for the position for which you have been selected.

Applying for a Position in the Corporation

1. Print all information requested on the Employment Application Form. See Fig. 77-2.

Problem 3

Objective

Using the figures on the Organization Chart (Fig. 77-1), compute accurately the weekly payroll for the corporation.

Supplies (Class)
30 shts. $8\frac{1}{2}''$ x 11″ paper for figuring

Totaling the Payroll

1. List on a piece of paper the weekly pay for all employees below the executive level. Add the column of figures to find the total wage payroll for one week. NOTE: The total of the executive salaries is already posted. Add the total salaries of the executive to the total of wages to find the total payroll.
2. Record the total payroll at the bottom of the Organization Chart. See Fig. 77-1.

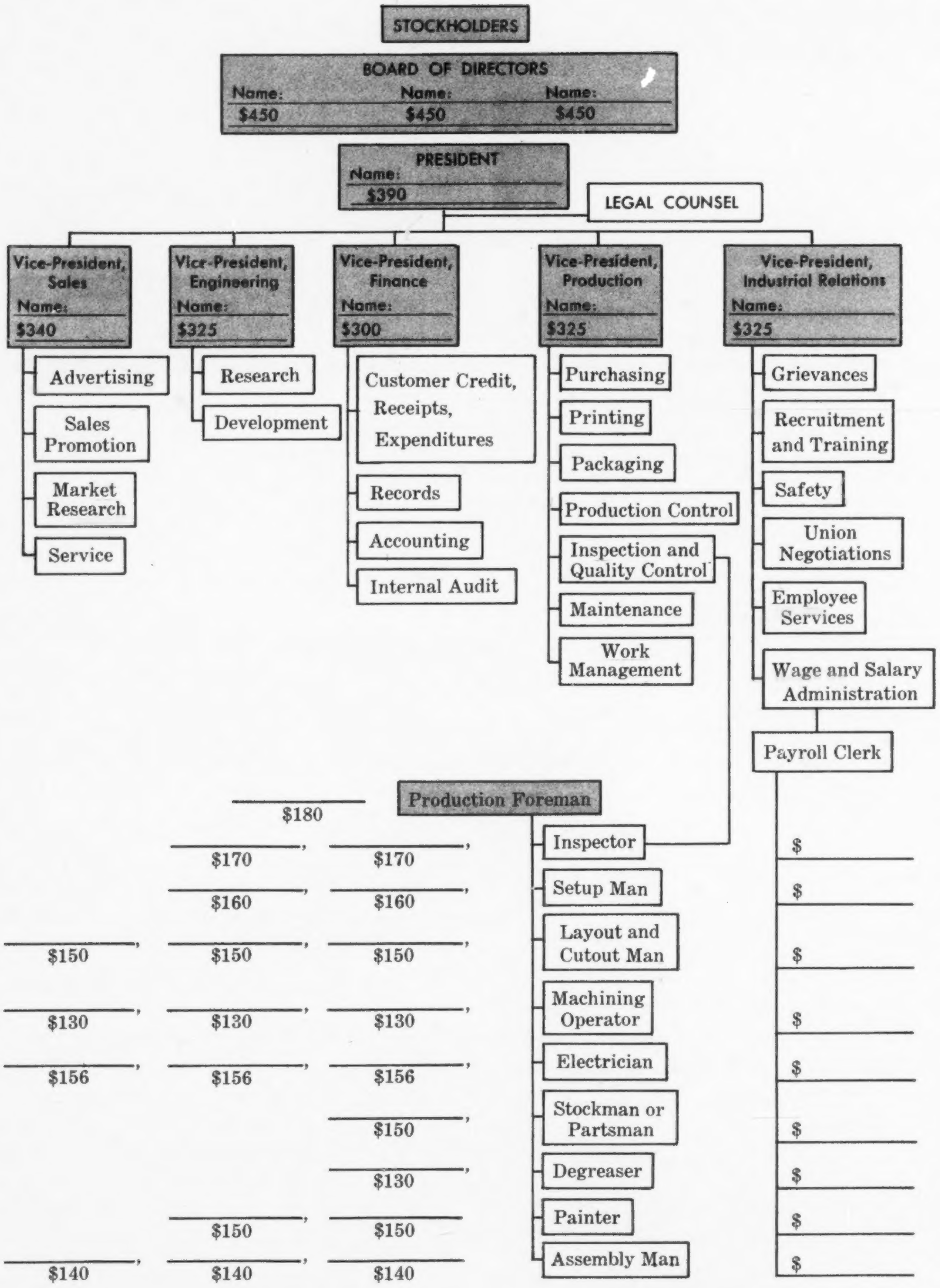
Problem 4

Objective

Using six photographs of workers, Figs. 77-3 to 77-8, (a) identify those who represent management and, (b) those who are production workers. Also identify jobs as skilled, semiskilled, and unskilled.

Identifying People in Jobs

1. Assume that all the people in the photographs work for the same company. The man shown in Fig. 77-3 is a *production* worker doing a *skilled* job. The words "Production" and "Skilled" have been filled in to show you how to do this problem.


STOCKHOLDERS
BOARD OF DIRECTORS
Name:
Name:
Name:
$450
$450
$450
PRESIDENT
Name:
$390
LEGAL COUNSEL
Vice-President, Sales
Name:
$340
Vice-President, Engineering
Name:
$325
Vice-President, Finance
Name:
$300
Vice-President, Production
Name:
$325
Vice-President, Industrial Relations
Name:
$325
Advertising
Sales Promotion
Market Research
Service
Research
Development
Customer Credit, Receipts, Expenditures
Records
Accounting
Internal Audit
Purchasing
Printing
Packaging
Production Control
Inspection and Quality Control
Maintenance
Work Management
Grievances
Recruitment and Training
Safety
Union Negotiations
Employee Services
Wage and Salary Administration
Payroll Clerk
Production Foreman
$180
$170, $170,
$160, $160,
$150, $150, $150,
$130, $130, $130,
$156, $156, $156,
$150,
$130,
$150, $150
$140, $140, $140
Inspector
Setup Man
Layout and Cutout Man
Machining Operator
Electrician
Stockman or Partsman
Degreaser
Painter
Assembly Man
$
$
$
$
$
$
$
$
$

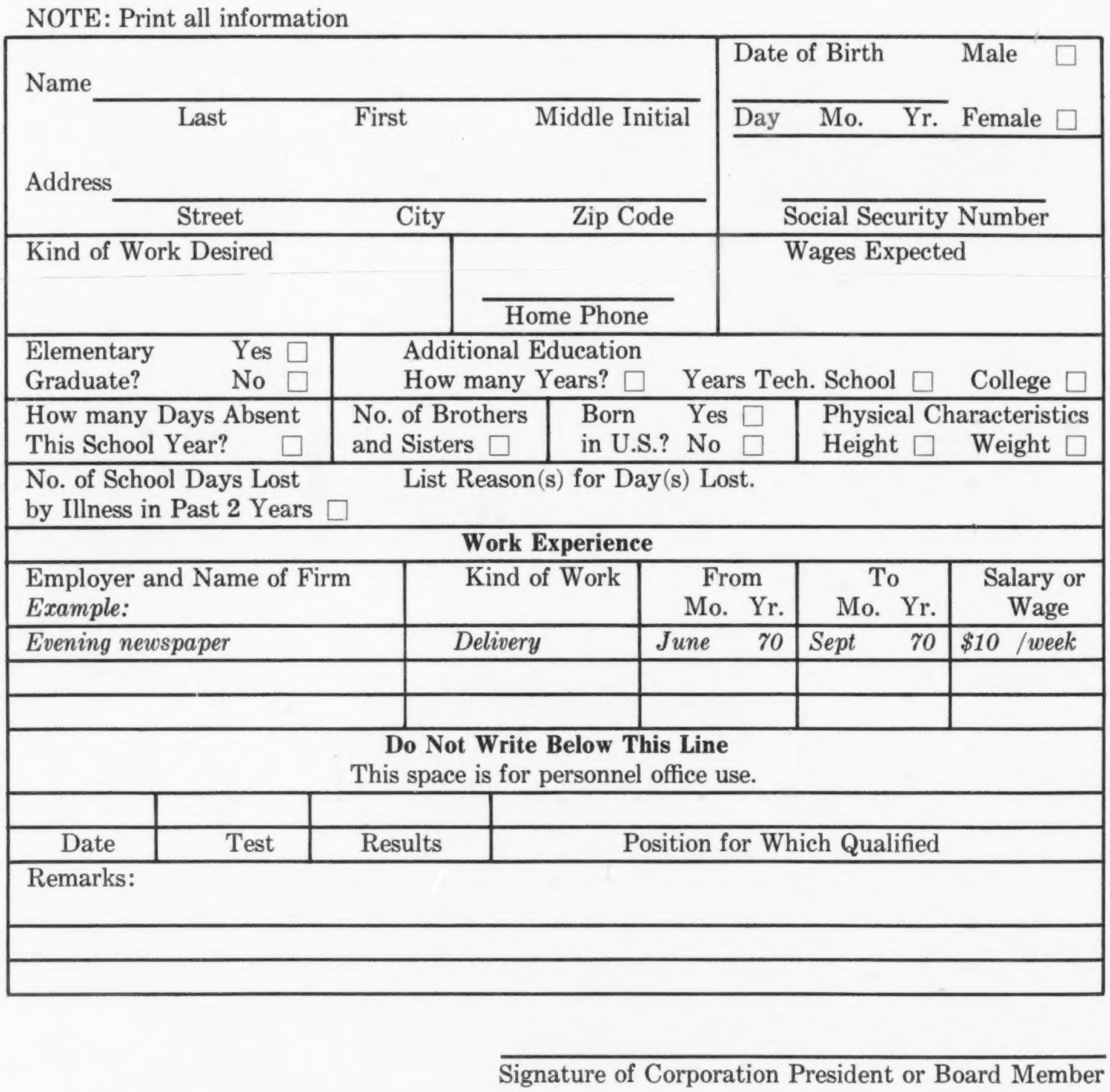
Total Wages ______

Total Salaries $3355

Total labor cost for *one*
week of operation (salaries and wages) Total Salaries and Wages ______ (total payroll)

Fig. 77-1. Organization Chart

Fig. 77-2. Employment Application



NOTE: Print all information

Name ____________________ Last First Middle Initial	Date of Birth Male ☐ Day Mo. Yr. Female ☐
Address ____________________ Street City Zip Code	Social Security Number

Kind of Work Desired	Home Phone	Wages Expected

Elementary Graduate? Yes ☐ No ☐	Additional Education How many Years? ☐ Years Tech. School ☐ College ☐

How many Days Absent This School Year? ☐	No. of Brothers and Sisters ☐	Born in U.S.? Yes ☐ No ☐	Physical Characteristics Height ☐ Weight ☐

No. of School Days Lost by Illness in Past 2 Years ☐	List Reason(s) for Day(s) Lost.

Work Experience

Employer and Name of Firm *Example:*	Kind of Work	From Mo. Yr.	To Mo. Yr.	Salary or Wage
Evening newspaper	*Delivery*	*June 70*	*Sept 70*	*$10 /week*

Do Not Write Below This Line

This space is for personnel office use.

Date	Test	Results	Position for Which Qualified

Remarks:

Signature of Corporation President or Board Member

2. On the (A) blank under each figure enter either *Management* or *Production.* (There is some clue in each picture.)
3. Under management pictures enter in the (B) space either *stockholders* or *officers.*
4. Under production pictures enter in the (B) space *skilled, semiskilled,* or *unskilled.* (Use your judgment or guess.) See Figs. 77-3 to 77-8.

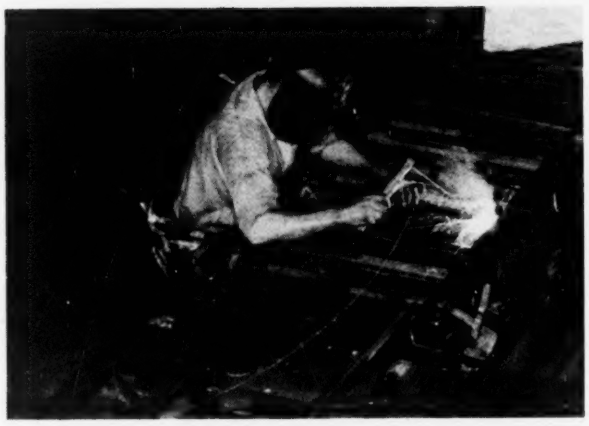


Fig. 77-3

A. ______________________________

B. ______________________________

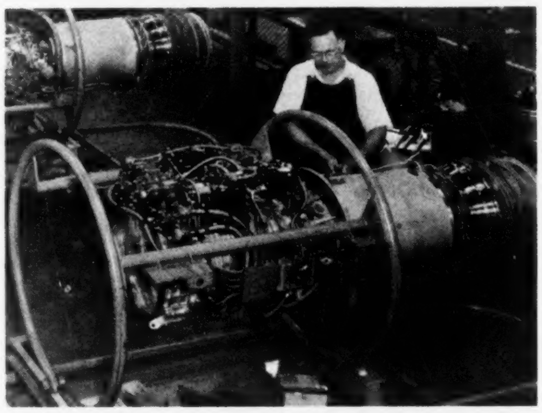


Fig. 77-4

A. ______________________________

B. ______________________________

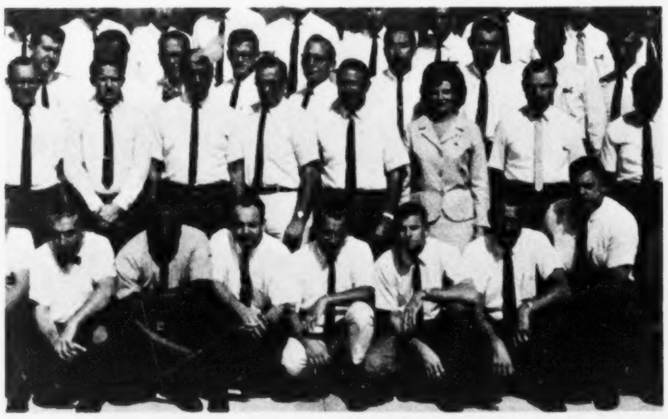


Fig. 77-5

A. ______________________________

B. ______________________________

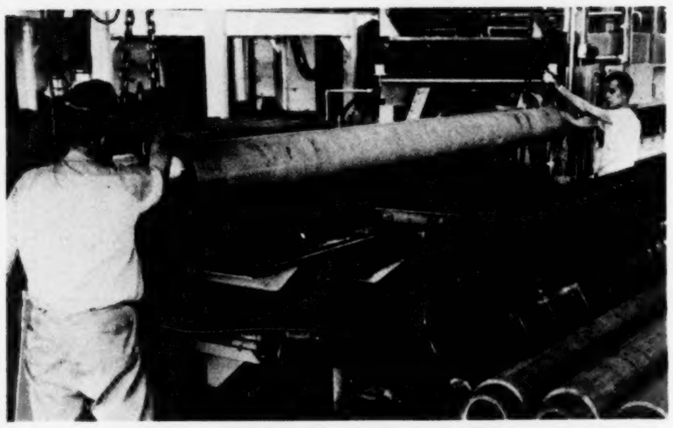


Fig. 77-6

A. ______________________________

B. ______________________________

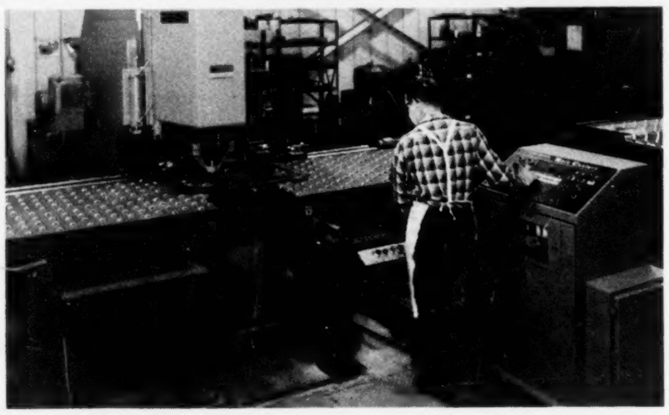


Fig. 77-7

A. ______________________________

B. ______________________________

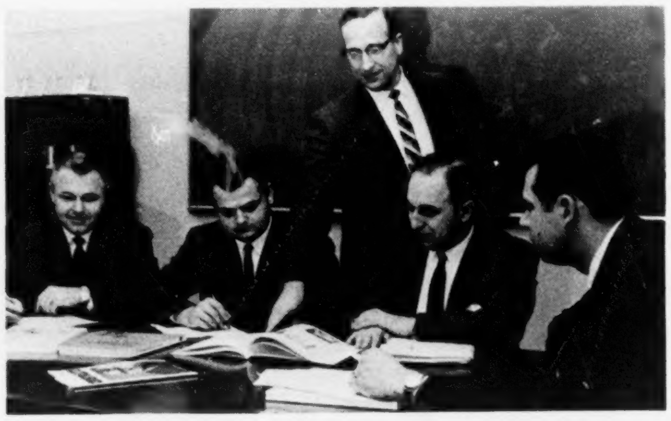


Fig. 77-8

A. ______________________________

B. ______________________________

Questions

1. Often the success of a company depends on the loyalty of its employees.

   ______ True ______ False
2. "Stamina" refers to the ability to work hard without tiring quickly.

   ______ True ______ False
3. A high school education is enough for most managers.

   ______ True ______ False
4. Management does not have to worry about the attitudes of people selling its product in retail stores.

   ______ True ______ False
5. A worker must take pride in his work whether he is unskilled, semiskilled, or skilled.

   ______ True ______ False
6. Semiskilled and skilled workers usually require a high school education, while unskilled workers often do not.

   ______ True ______ False
7. The attitudes of employees do not affect efficient production.

   ______ True ______ False
8. A proprietorship involves ownership by two or more people.

   ______ True ______ False

LABORATORY NOTES

ACTIVITY 78A

Designing and Engineering the Product

A manufacturer must plan every detail of his product before production begins. He must be sure that it will be able to compete in quality and price with similar products on the market. Now that your corporation has been organized, the product designing and engineering phase can proceed.

Problem

Objective

Using patterns of the lamp components, cut out and assemble the components to make an appearance mock-up of the lamp.

Equipment (Group of 5)
4 pr. scissors

Supplies (Group of 5)

4 pcs.	9″ x 12″ postcard stock (.010″) *or* equivalent
1 roll	masking tape
1 tube	rubber cement
4 pcs.	carbon paper
1 pc.	½″ x 12″ dowel rod
1 pc.	8½″ x 11″ plain paper
1 box	assorted colors of crayons
1 can	spray paint, brown

Preparing to Work

1. Get the equipment and supplies needed for your group. Four members of your group will need to use scissors. Share them if necessary.
2. Your teacher will give you instructions on the correct procedure to follow in making and cutting out your components. See Figs. 78A-1 through 78A-5.

Safety

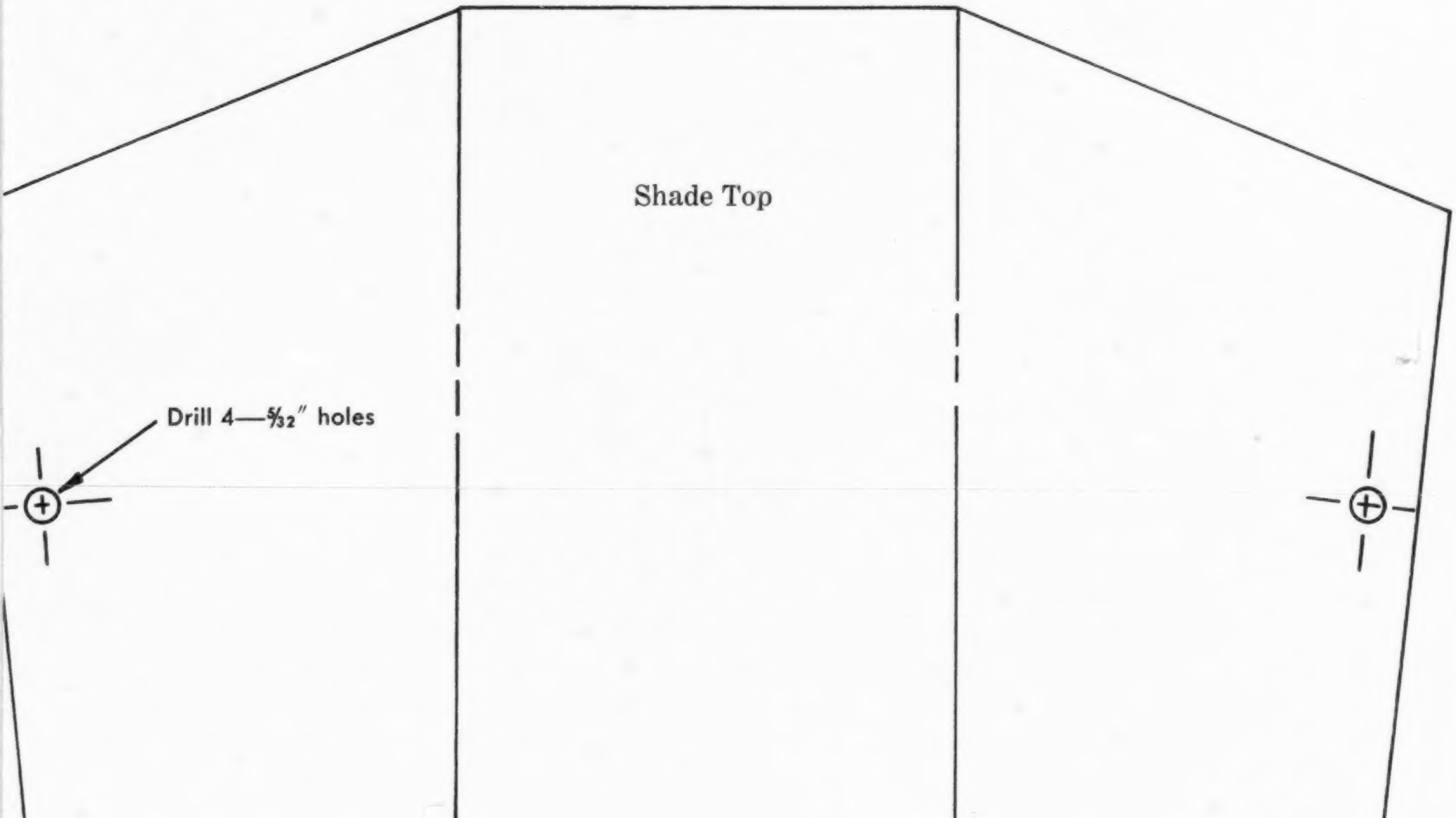
Exercise care in the use of sharp pointed instruments.

Making the Appearance Mock-Up

3. You should cut out per group, 1 shade top, 1 shade bottom, 1 base top, 1 base bottom, and 1 hanger bracket. The *large hole* in the base top piece also should be cut out.
4. Fold the component patterns along the broken lines.
5. Insert on end of the dowel rod through the hole in the base top. Using masking tape, anchor the dowel rod to the base bottom at the indented hole.
6. Assemble the two base components and the two shade components. Tape or glue all flaps or edges with masking tape and cement. Attach hanger bracket to shade bottom.
7. Tape the shade subassembly to the stem as shown in Figs. 78A-6 and 78A-7. These figures also show how the completed mock-up will look.
8. Enter your class section and group number on a small piece of tape, and attach it to your lamp mock-up.
9. Your teacher will check the mock-up for each group and put the best one or two on display.

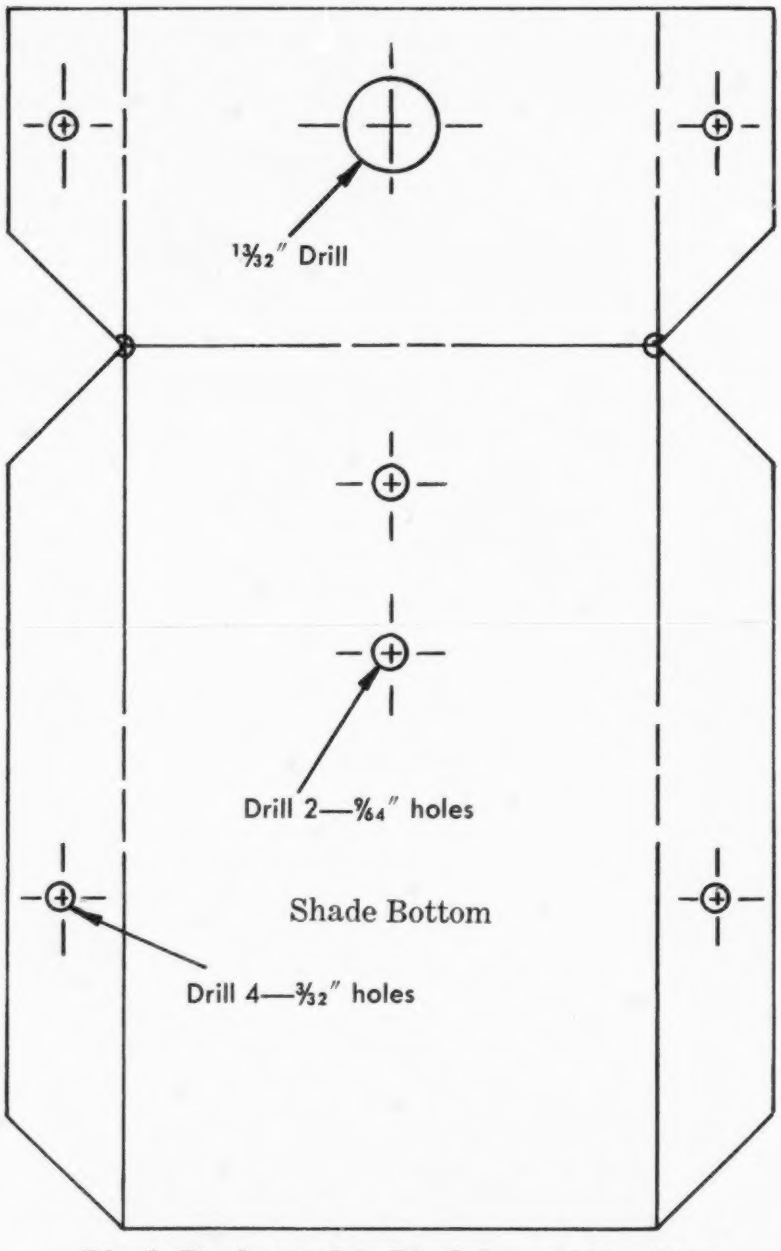
Cleaning Up

10. Deposit all scrap paper in a waste container and return the scissors, tape and rubber cement to the storage area.


Shade Top
Drill 4—5/32″ holes
Drill 2—1/16″ holes

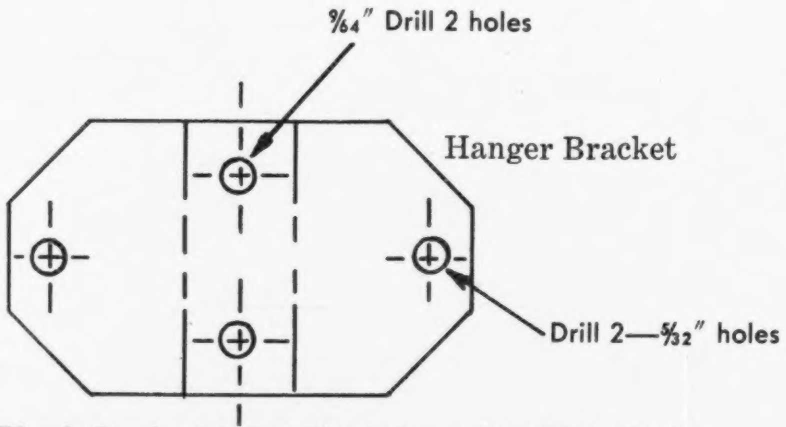
Blank Stock: 26 GA. Black Iron 7½″ x 7″

Fig. 78A-1. Shade-Top Pattern


13/32" Drill
Drill 2—9/64" holes
Shade Bottom
Drill 4—3/32" holes

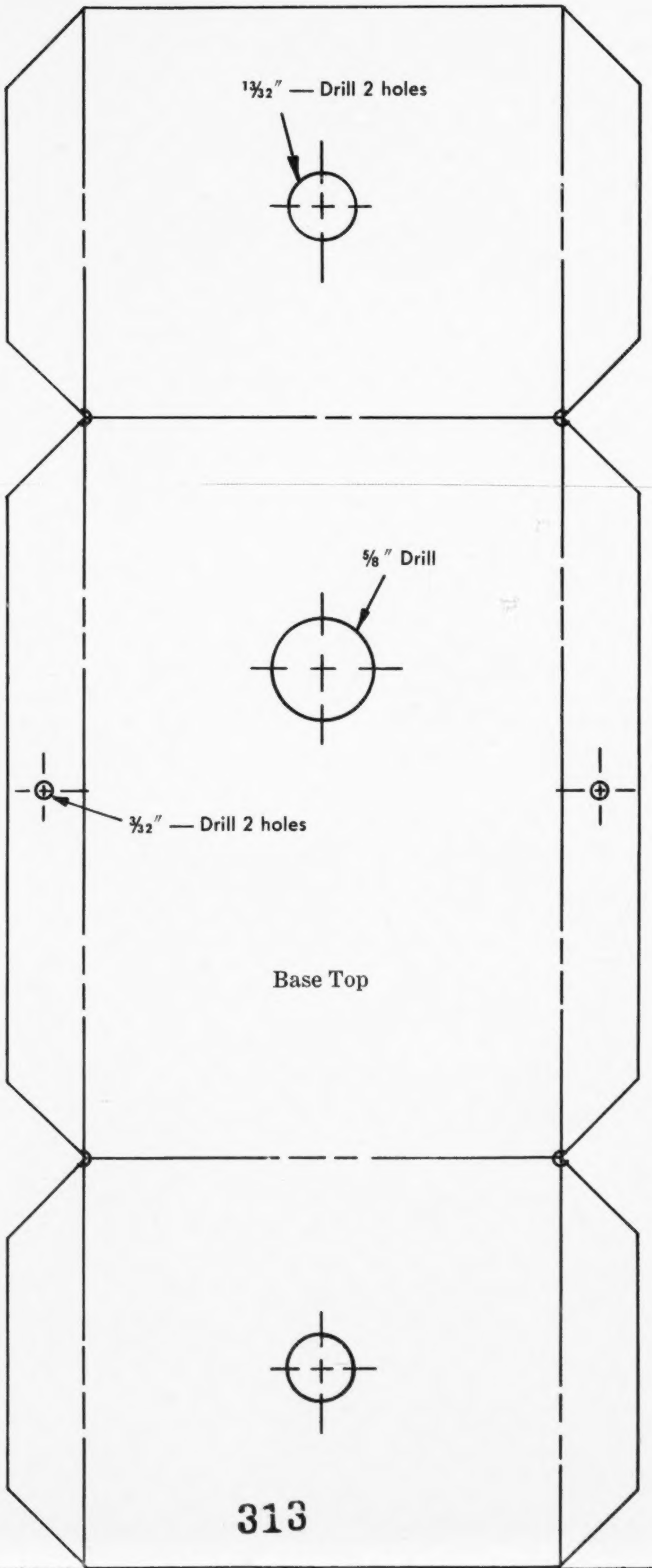
Blank Stock: 26 GA. Black Iron 3½" x 5½"

Fig. 78A-2. Shade-Bottom Pattern


9/64" Drill 2 holes
Hanger Bracket
Drill 2—5/32" holes

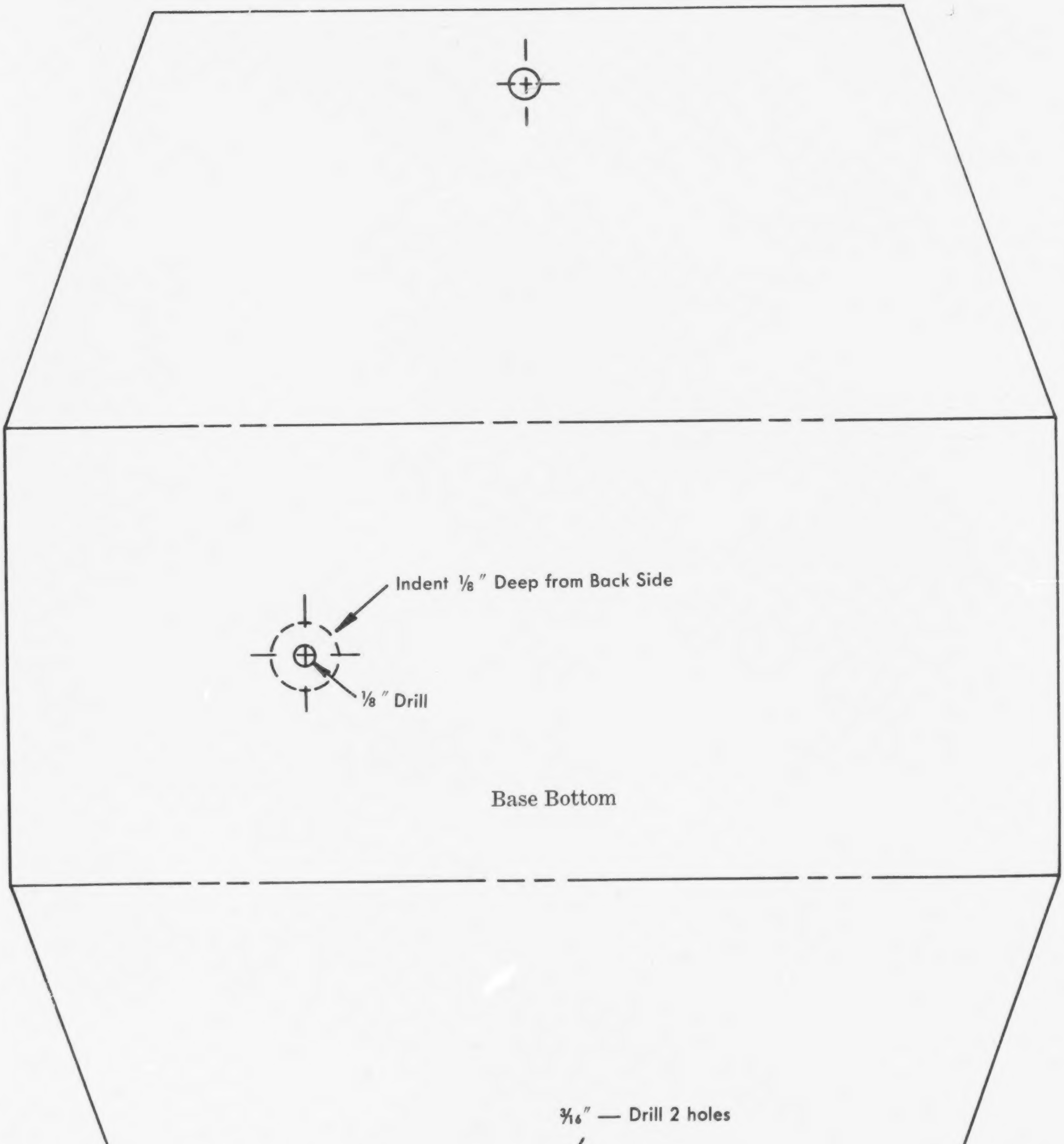
Blank Stock: 26 GA. Black Iron 1¼" Wide Strip

Fig. 78A-3. Hanger Bracket Pattern


13/32" — Drill 2 holes
5/8" Drill
3/32" — Drill 2 holes
Base Top

Blank Stock:
26 GA. Black Iron
4" x 9¾"

Fig. 78A-4. Base-Top Pattern


Indent ⅛" Deep from Back Side
⅛" Drill
Base Bottom
3/16" — Drill 2 holes

Blank Stock: 26 GA. Black Iron 7" x 8½"

Fig. 78A-5. Base-Bottom Pattern

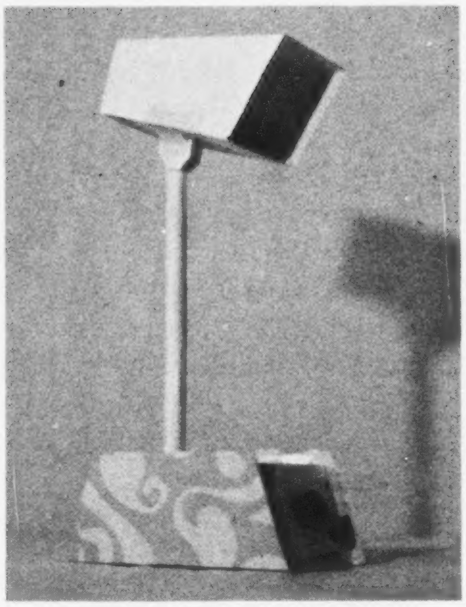


Fig. 78A-6. Completed Mock-Up

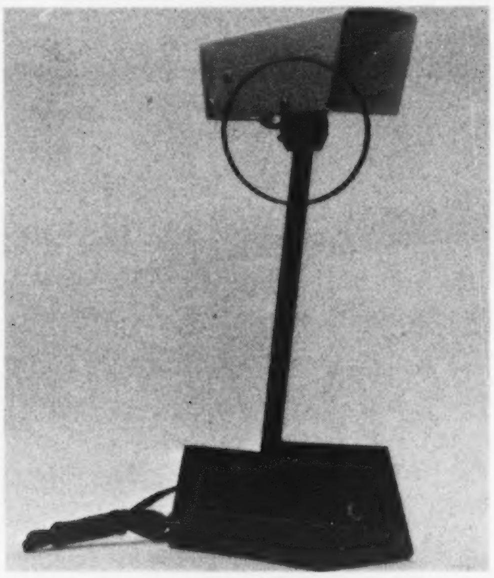


Fig. 78A-7. Hanger Bracket Detail

ACTIVITY 79

Making the Sales Forecast

Today you will conduct a consumer survey and make a sales forecast.

Problem 1

1. Based on design, which desk lamp would you choose?
________A ________B ________C
2. Based on estimated cost, which desk lamp would you choose?
________A ________B ________C
3. Would you purchase more than one?
________Yes ________No
4. For what purpose would you use the lamp?
________General reading or study
________Job or hobbies (like electronics or stamp collecting)
5. Which of these would influence you most in buying a lamp?
________(a) Design
________(b) Amount of Light
________(c) Cost
________(d) Quality of Work
________(e) Convenience
6. How much would you pay for a desk lamp?
________A. $10.00
________B. $8.00
________C. $6.00
7. Which of the three lamps would be the hardest to manufacture?
________A ________B ________C

Fig. 79-1. Student Survey Form

Objective

Given a consumer survey situation, complete seven items on the survey form.

Surveying Consumers

1. Assemble with your group.
2. Your foreman will conduct a consumer interview within your group. He will ask you to respond to each question on Fig. 79-1 and he will record your answers.

   (NOTE to group foreman: Assume that you are the market researcher for the lamp corporation and the market is in your state.)

Problem 2

Objective

Given the results of a consumer survey, compile seven items of information from the survey forms and make a sales forecast.

Counting Votes

1. As a group, you will tally the number of preferences (or votes) *in your group* for each item. Use one copy of Fig. 79-2 to record the voting.
2. Your teacher will receive a report from each foreman and help tally the results for the class.
3. In the "Results" column of Fig. 79-2 record the voting data from the survey.

Making the Sales Forecast

4. Based on the survey, what are the most wanted characteristics of a desk lamp?

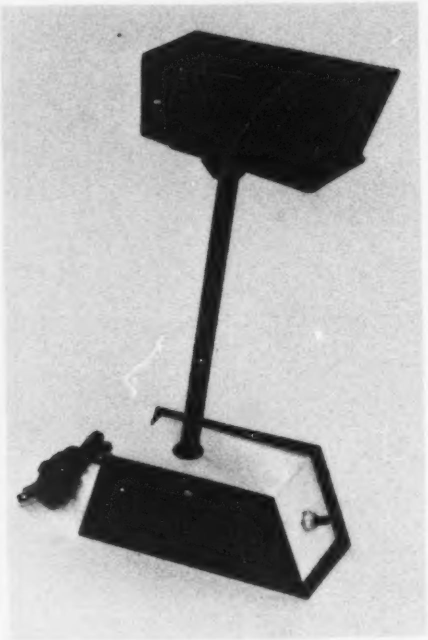
____

____

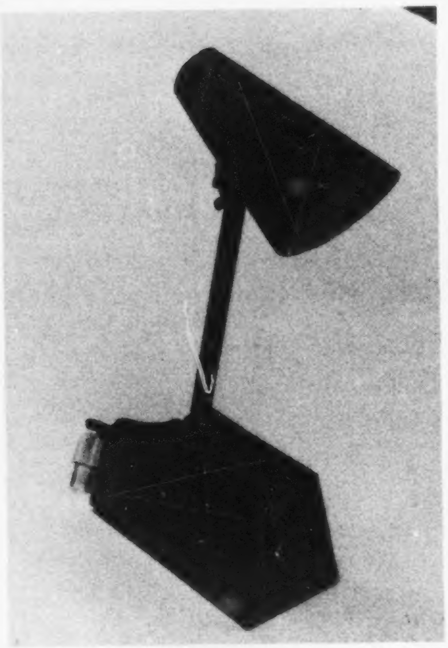
____

5. How many lamps with the above characteristics can be expected to be sold?

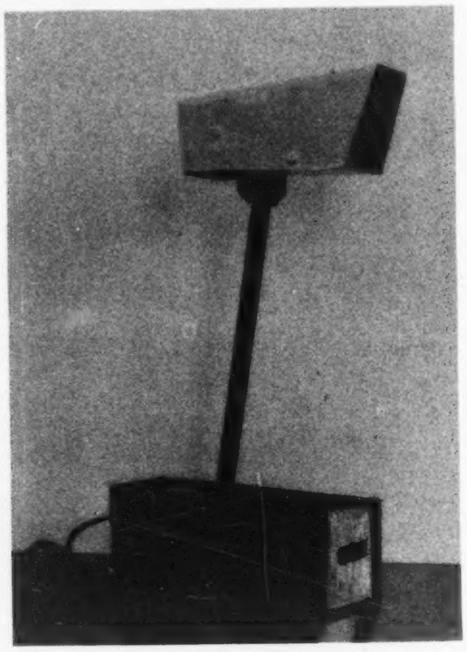
____



A



B



C

Fig. 79-2. Student Survey Results

Results

1. Most popular lamp:
_______A _______B _______C _______
2. Choice based on cost:
_______A _______B _______C _______
3. Would you purchase more than one?
_______Yes _______No _______
(number)
4. Most common purpose:
_______General
_______Job or Hobbies _______
5. Most influential factor:
___ ___ ___ ___ ___ _______
(a) (b) (c) (d) (e)
6. How much would you pay?
_______A _______B _______C _______
7. Difficulty of manufacture:
_______A _______B _______C _______

ACTIVITY 78B

Designing and Engineering the Product

Today you will prepare a parts list, an assembly drawing, and an electrical schematic drawing.

Problem 1

Objective

Using an exploded drawing, with all parts numbered and a list of part names, complete a parts list.

Matching Part Numbers and Names

1. On Fig. 78B-3, find the part identified as 2. It is one of two main shade parts. On Fig. 78B-1 find the name of this part. It is the

   ____________________.

2. On Fig. 78B-2, record the name of this part on the proper line.
3. Find each part on the drawing, identify its name on Fig. 78B-1, and record the name on Fig. 78B-2.

MAIN PARTS
Base bottom
Base top
Bulb
Electrical plug
Hanger bracket
Lamp cord
Shade bottom
Shade top
Socket
Stem
Switch

HARDWARE
Pan-head sheet metal screw
Flat-head machine screw w/hex nut
Round-head machine screw w/wing nut
Pop rivet
Wire nut
Nipple w/hex nut
Brass washer

MISCELLANEOUS
Adhesive-back felt square
½″ I.D. rubber grommet
¼″ I.D. rubber grommet
Wood-grain vinyl coating

Fig. 78B-1. List of Part Names

Problem 2

Objective

Using Fig. 78B-4, an incomplete three-view assembly drawing, complete the drawing.

Equipment (Group of 5)
1 appearance mock-up of lamp
5 12″ rules

Equipment (Class)
1 prototype of lamp

Drawing the Lamp

1. On Fig. 78B-4 *complete* the front, top, and end views. Show the switch, screw holes, and visible details.

Dimensioning

2. Measure and record the *dimensions* of the main lamp parts and the overall height. Measure your *appearance* mock-up to find shade and base dimensions. Measure the *height* on the prototype lamp.
3. Enter the *date* and *your name* on the

Fig. 78B-2. Parts List for Desk Lamp Model IACP-102

Part No.	Part Name
1.	shade top
7.	6-A 125V canopy switch, rotary, single pole
10.	#72-B wire nut (small)
13.	1/8" x 3/4" length pipe nipple with hex nut for socket
14.	1/4" I.D. rubber grommet
16.	#8 x 1/4" pan-head sheet metal screw
17.	#6-32 x 3/4" round-head machine screw with wing nut
18.	washer for #6-32 screw
19.	#6-32 x 1/2" flat-head machine screw with hex nut

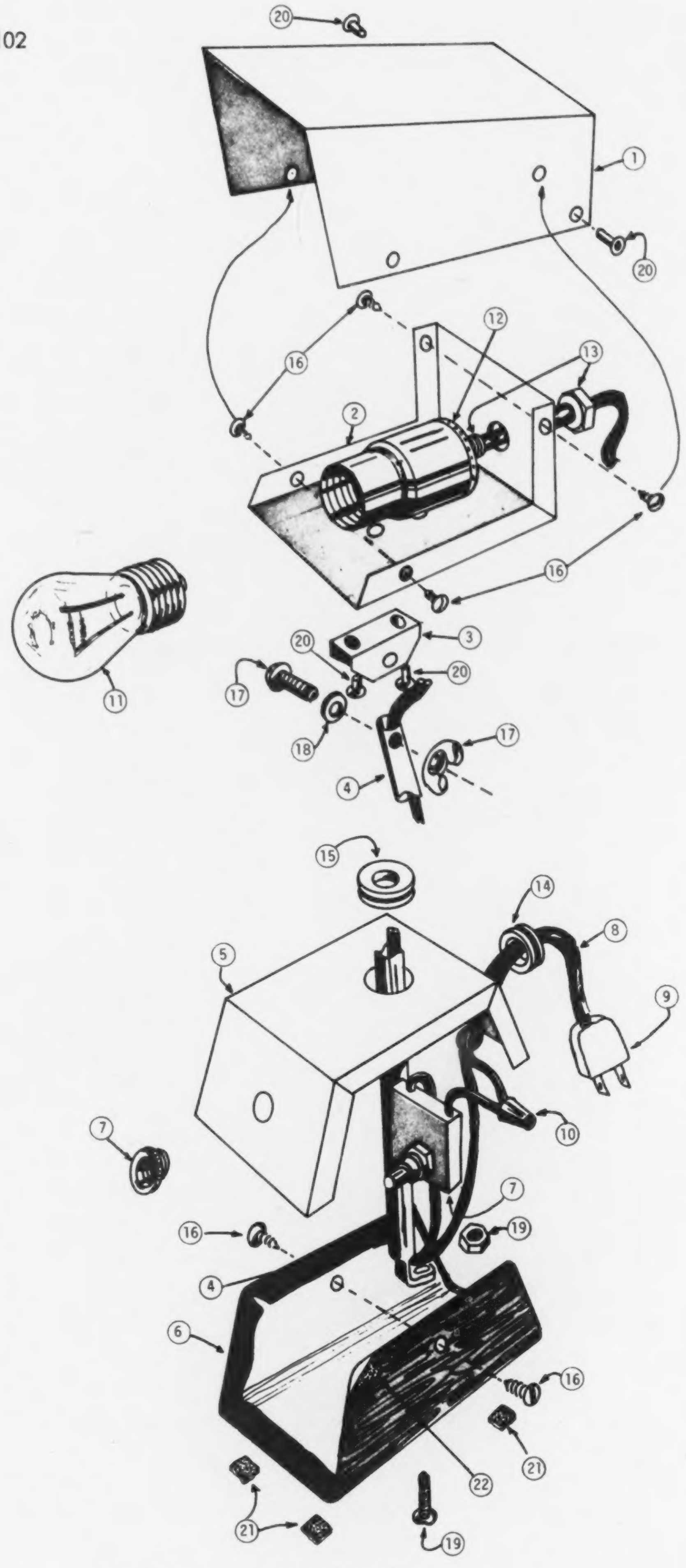


Fig. 78B-3. Exploded View of Lamp

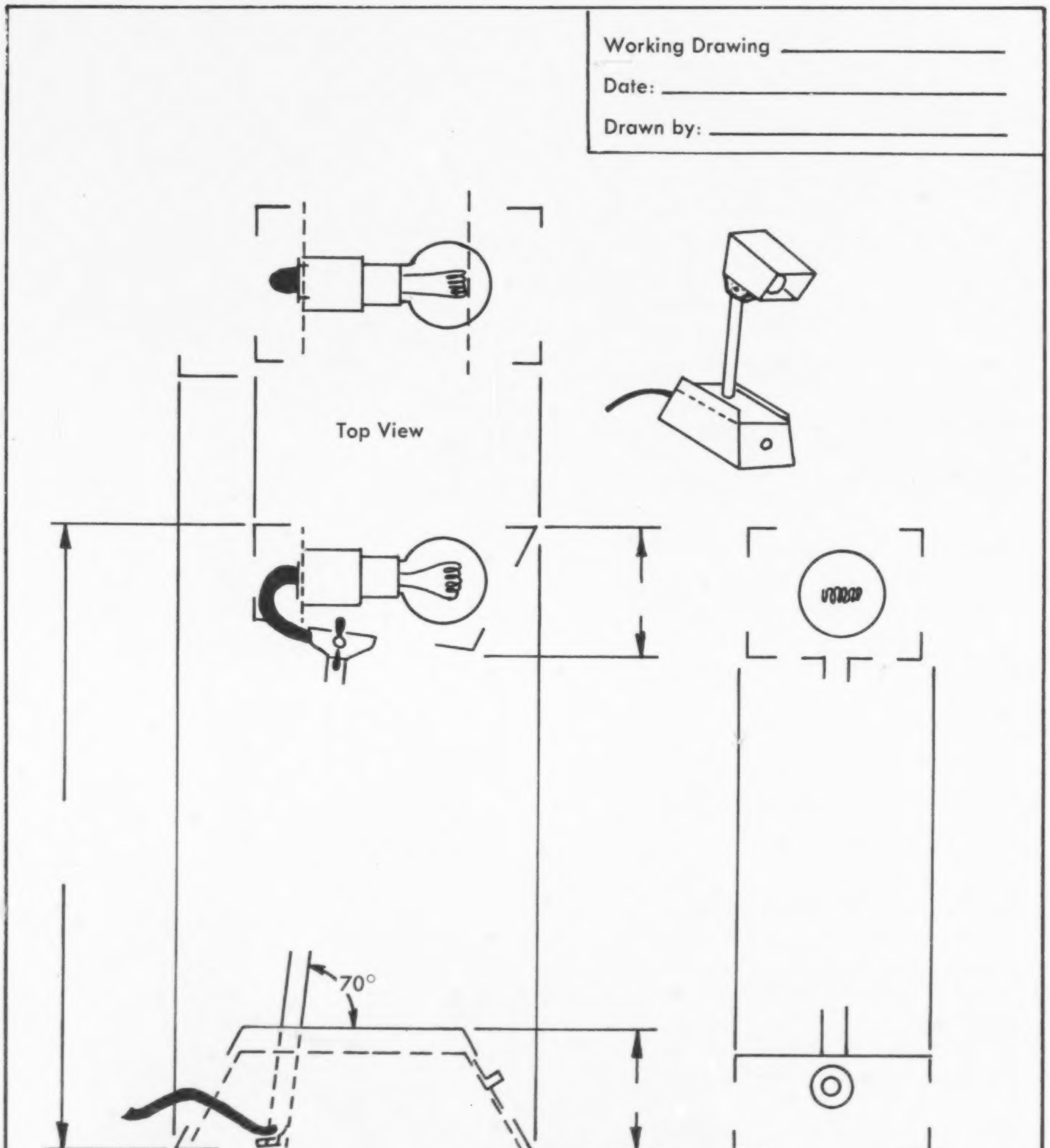
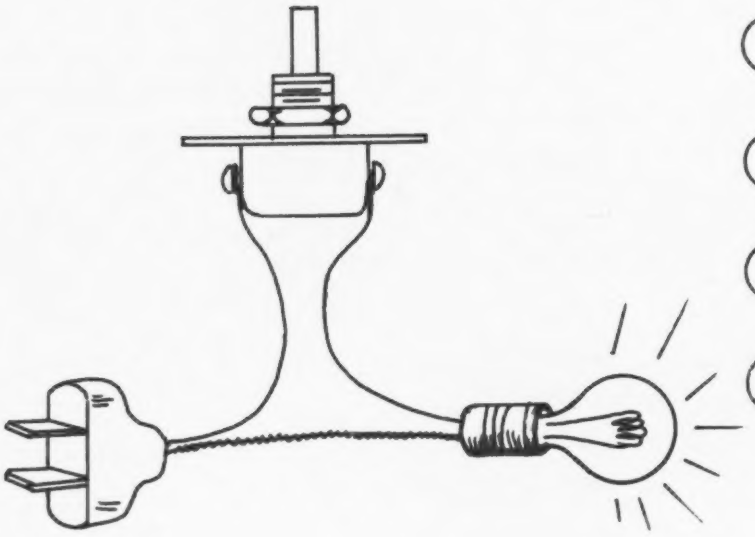
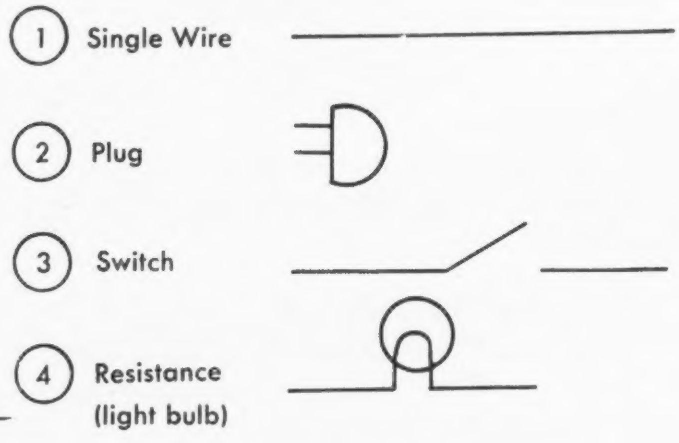

Working Drawing
Date:
Drawn by:
Top View
70°
Front View
Rear View

Fig. 78B-4. Working Drawing




1 Single Wire
2 Plug
3 Switch
4 Resistance (light bulb)

For Sketch

Schematic for Lamp

Date: ____________________

Drawn by: ____________________

Fig. 78B-5. Schematic for Lamp

drawing in the upper right corner. See Fig. 78B-4.

Objective

Using a pictorial electrical drawing and symbols, Fig. 78B-5, sketch an electrical schematic.

Drawing the Schematic

1. Figure 78B-5 shows electrical symbols for a light bulb, wire, switch, and plug. It also shows a pictorial drawing of lamp components in a *series* circuit.
2. In the space provided on Fig. 78B-5, sketch a schematic showing a switch, plug, and bulb wired in series. This is done by substituting the symbols for the pictorially drawn parts.
3. Enter your name and the date on the drawing. See Fig. 78B-5.

Cleaning Up

4. Clean up your work area and return the rule to storage.

ACTIVITY 78C

Designing and Engineering the Product

Today you will make the shade components for the lamp prototype.

Problem

Objective

Using a pattern, sheet metal, and necessary tools, make the shade components for the desk lamp prototype.

Equipment (Class)

1	squaring shear
1	box and pan brake
1	bar folder, if available
1	center punch
1	scratch awl
1	ball peen hammer
2	4″ C-clamps
1	1/16″ twist drill
1	9/64″ twist drill
1	5/32″ twist drill
1	13/32″ twist drill
1	3/32″ twist drill
1	⅝″ twist drill
2	drill fixtures No. 149-1, for drilling shade bottoms
1	hanger bracket template No. 149-2
2	drill jigs No. 149-3, for hanger bracket and lamp stem No. 149-3
3	temporary drill fixtures
1	hanger bracket bending fixture No. 149-4
1	drilling jig No. 149-5
1 pr.	combination pliers
1 pr.	tin snips
1	hand notcher 90°
1 pr.	scissors
1	mill file, 8″ or 10″
1	drill press
1	pop rivet gun
1 set	No. 5 Whitney Jr.® metal punch

Supplies (Class)

6	duplicated copies of each lamp, components 1, 2, 3
3 btls.	rubber cement
6 pcs.	26 *or* 28 ga. black iron, 7½″ x 7¾″, Part 1, shade top
6 pcs.	26 *or* 28 ga. black iron, 3½″ x 5½″, Part 2, shade bottom
6 pcs.	26 *or* 28 ga. black iron, 1¼″ x 30″, Part 3, hanger bracket
10	⅛″ x ⅛″ pop rivets

Preparing to Work

1. Obtain equipment, supplies, and instruc*tions for your group assignment.*
2. Your instructions include working sketches and pictures of the step-by-step procedures. See Figs. 78C-1, 78C-2, and 78C-3, and refer to the instruction panel for the component on which you are working.

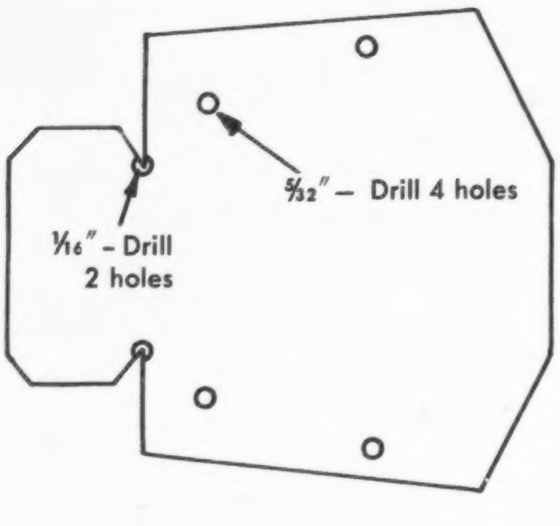


Fig. 78C-1. Shade Top, Part #1

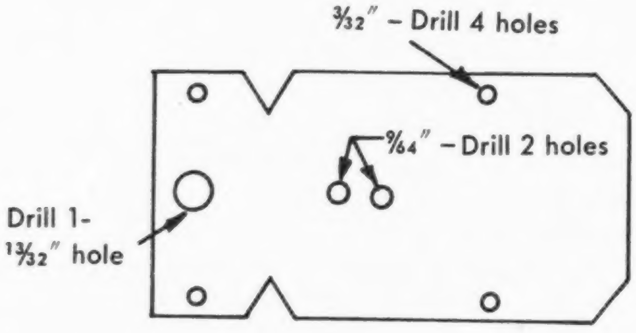


Fig. 78C-2. Shade Bottom, Part #2

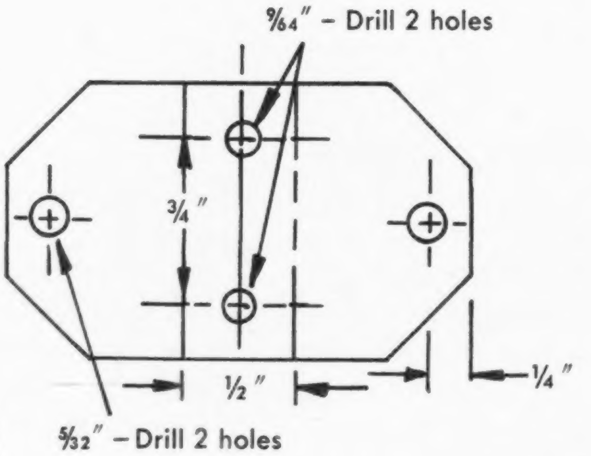


Fig. 78C-3. Hanger Bracket, Part #3

Making Components

3. Cement your assigned pattern to the sheet-metal blank with rubber cement. The teacher will instruct you where to obtain patterns and templates.

Safety

a. Safety glasses must be worn at all times when using machines or tools.
b. Any metal being drilled at the drill press or with an electric hand drill must be held in place with clamps and fixtures.

4. The pattern will show you where and what size to punch or drill holes, and also where to shear and bend the metal. Use the fixture to hold the metal while drilling. See Fig. 78C-1.
5. Refer to Fig. 78C-2 and to your teacher's demonstration to complete the lamp components. Each group is to make five components.

Cleaning Up

6. Clean up your work area. Place all scraps of metal in the waste can. Return all equipment and supplies to the storage area assigned by the teacher.
7. Deliver all completed components and materials to designated area.

ACTIVITY 78D

Designing and Engineering the Product

Today you will make the stem, base, top, and base bottom.

Problem

Objective

Using the patterns, templates, sheet metal or tubing, and the necessary tools, make five each of three lamp components for the prototype.

Equipment (Class)

1	hacksaw
1	squaring shear
1	box and pan brake
1	bar folder (if available)
1	center punch
1	scratch awl
1	ball peen hammer
2	4" C-clamps
1	3/16" twist drill
1	1/16" twist drill
1	9/64" twist drill
1	5/32" twist drill
1	5/16" twist drill
1	13/32" twist drill
1	3/32" twist drill
1	5/8" twist drill
2	drill fixtures No. 149-1, for drilling base top
1	drill jig No. 149-3
1	temporary drill fixture, for drilling base bottom
1	saw jig No. 150-1 for stem
1	squeeze fixture No. 150-2, for stem
1	drill jig No. 150-3, for stem
1	bending fixture No. 150-4, for stem
1 pr.	combination pliers
1 pr.	tin snips
1	90° hand notchers
1 pr.	scissors
1	mill file, 8" *or* 10"
1	round file
1	drill press
1	No. 5 Whitney Jr.® metal punch, *or* equivalent

Supplies (Class)

6	duplicated copies of each lamp component
3 btls.	rubber cement
6 pcs.	20 *or* 22 ga. black iron, 7" x 8½"
6 pcs.	26 *or* 28 ga. black iron, 4" x 9¾"
6 ft.	½" O.D. aluminum tubing

Preparing to Work

1. Obtain equipment, supplies, and instructions for your group assignment.
2. Your instructions include working sketches and pictures of the step-by-step procedures. See Figs. 78D-1, 78D-2, 78D-3, and refer to the instruction panels of the component on which you are working.

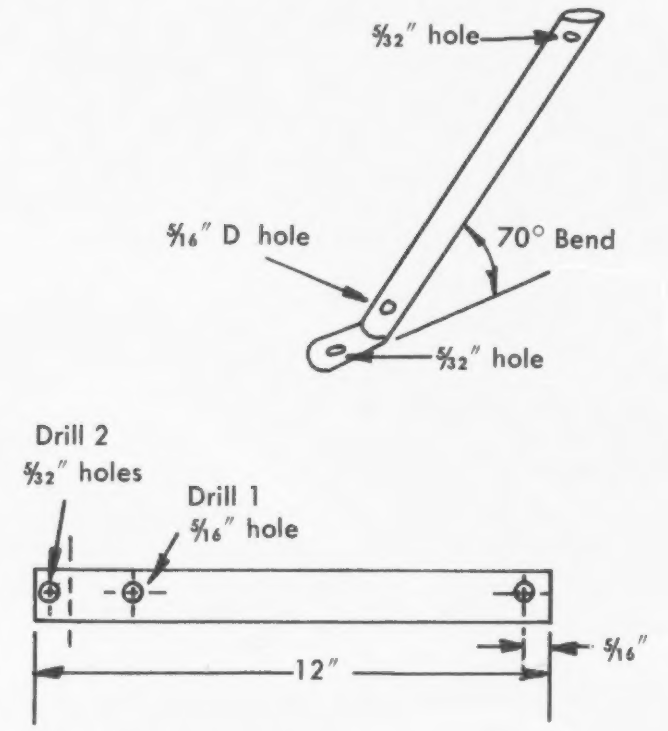
Making Components

3. Cement your assigned pattern to the sheet metal blank. The teacher will tell you where to obtain patterns and templates.
4. Patterns will show you where to punch or drill specified size holes, and also where to shear and bend the metal. Use the fixtures to hold the metal while drilling, Fig. 78D-1.

Safety

a. Safety glasses must be worn at all times when using machines or tools.
b. Any metal being drilled at the drill press, or with an electric hand drill, must be held in place securely with clamps.

325


5/32" hole
5/16" D hole
70° Bend
5/32" hole
Drill 2
5/32" holes
Drill 1
5/16" hole
12"
5/16"

1/2" O.D. Tube, Aluminum, .035 Wall

Fig. 78D-1. Stem, Part #1

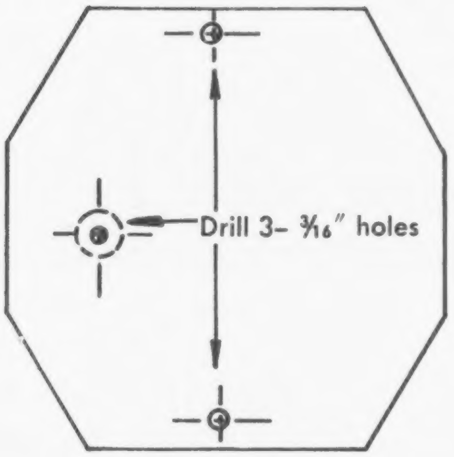

Drill 3- 3/16" holes

Fig. 78D-3. Base Bottom, Part #6

5. Refer to Fig. 78D-1 and to your teacher's demonstration to complete the lamp component. Each group is to make five components.

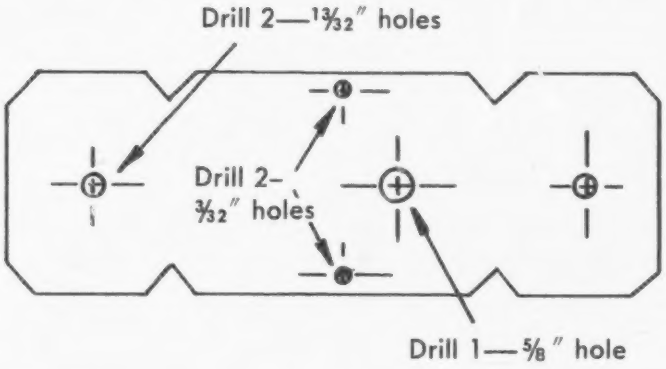

Drill 2—13/32" holes
Drill 2-
3/32" holes
Drill 1—5/8" hole

Fig. 78D-2. Base Top, Part #5

Cleaning Up

6. Clean up your work area. Place all scraps of metal in the waste can. Return all equipment and supplies to the storage area assigned by the teacher.

7. Deliver all completed components and materials to designated areas.

ACTIVITY 78E

Designing and Engineering the Product

Today you will combine components to make a prototype of the desk study lamp.

Problem

Objective

Using the components that were manufactured previously, assemble a prototype that will be an actual working model of the high-intensity desk lamp.

Equipment (Class)

10	screwdrivers, 4″ *or* 6″ blades
5	needle-nose pliers
5	bench knives *or* utility knives
5	diagonal cutters
5	wire strippers
5	adjustable wrenches 6″-8″
5	scribers
5	parallel jaw clamps

Supplies (Group of 5)

1 ea.	lamp components 1 through 6
1 pc.	No. 18-2 brown lamp cord, 7′
1	brown snap-on electrical plug
2	No. 72B wire nuts (small)
1	6-A, 125V canopy switch, rotary, single-pole
1	75W, 250V socket, base for high-intensity bulb
1	40W, 120V bulb, high-intensity
1	½″ rubber grommet, ½″ I.D., ⅝″ O.D.
1	¼″ rubber grommet, ¼″ I.D., 13/32″ O.D.
1	½″ x ⅜″ dia. nipple with hex nut
1	steel washer for No. 6-32 machine screws
1	hex nut, No. 6-32
1	No. 6-32 x ¾″ RH machine screw
1	wing nut No. 6-32
6	No. 6 x ¼″ pan-head sheet metal screws

Preparing to Work

1. The teacher will divide the class into five equal groups.
2. Each group obtain supplies and components to assemble one prototype.

Assembling Components

3. Each group is to assemble one prototype of the desk study lamp.

Safety

Have your teacher check your wiring of the components before you assemble the lamp.

4. Follow the step-by-step instructions on the operation sheets, all of which have been provided on the instruction panels. Refer to Fig. 78E-1 to help you in assembly of your lamp.
5. After the socket and switch have been wired, have your teacher check for bare wires that might cause a short in the wiring.
6. When completely assembled, plug in the lamp to see if the bulb will light and the switch will operate.
7. Clean up the work area and return the tools.
8. Take completed prototypes to designated storage areas.

Part No.	Part Name
1.	shade top
2.	shade bottom
3.	hanger bracket
4.	stem
5.	base top
6.	base bottom
7.	6-A 125V canopy switch, rotary, single pole
8.	#18 brown lamp cord
9.	brown snap-on plug
10.	#72-B wire nut (small)
11.	40-watt high-intensity bulb
12.	socket for high-intensity bulb
13.	$\frac{1}{8}$" x $\frac{3}{4}$" length pipe nipple with hex nut for socket
14.	$\frac{1}{4}$" I.D. rubber grommet
15.	$\frac{1}{2}$" I.D. rubber grommet
16.	#8 x $\frac{1}{4}$" pan-head sheet metal screw
17.	#6-32 x $\frac{3}{4}$" round-head machine screw with wing nut
18.	washer for #6-32 screw
19.	#6-32 x $\frac{1}{2}$" flat-head machine screw with hex nut
20.	$\frac{1}{8}$" x $\frac{1}{8}$" pop rivet
21.	$\frac{3}{4}$" x $\frac{3}{4}$" felt pads
22.	wood-grain vinyl

Fig. 78E-2. Parts List for Desk Lamp Model IACP-102

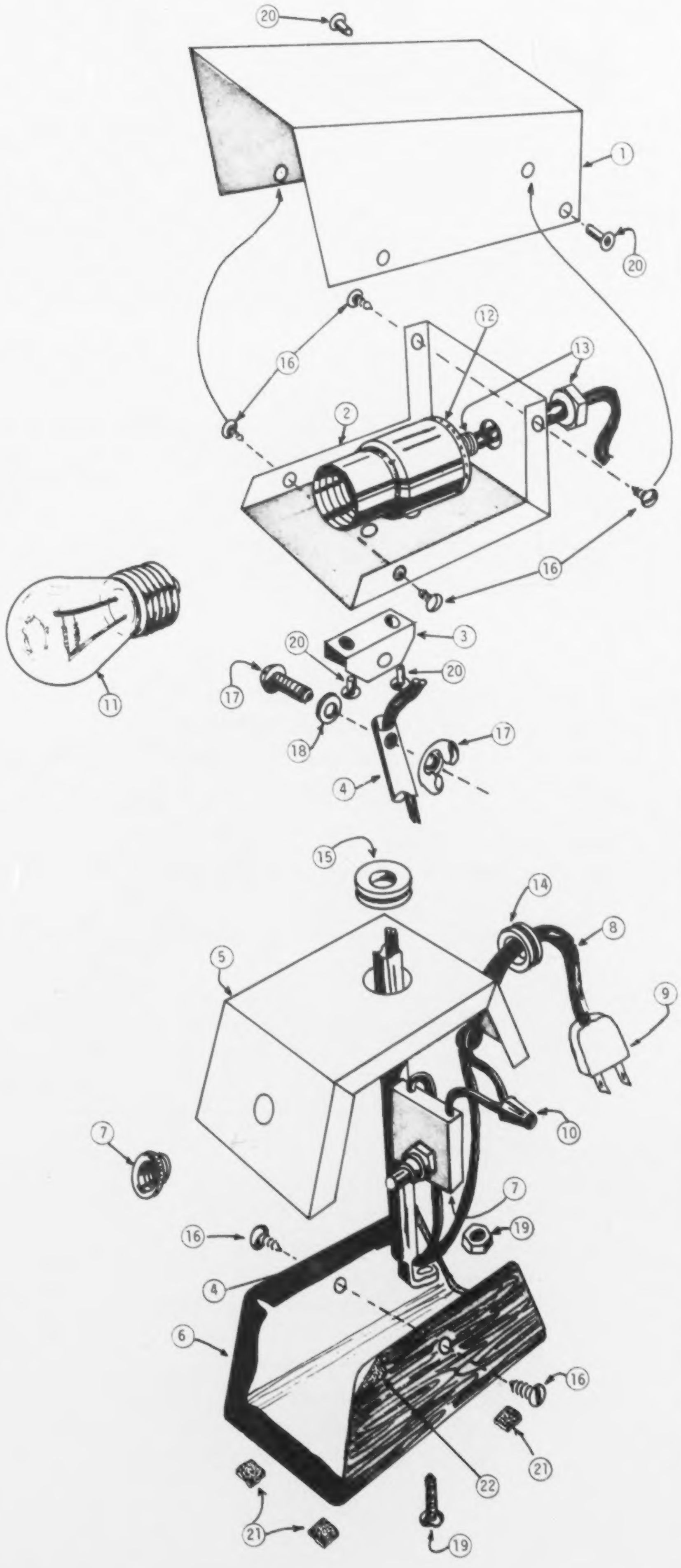


Fig. 78E-1. Exploded View of Lamp

ACTIVITY 80

Obtaining Capital, Estimating Profits and Keeping Records

Problem 1

Objective

Given cost and production figures, study how a *break-even chart* is arrived at and how *profits* are estimated.

Studying the Example

1. You want to earn money and then decide how to run a small business by cutting lawns one summer.
2. If you bought a lawnmower for $50.00 and spent 50¢ for gas and oil on every lawn cut, what would be the total initial *cost* of your business in order to cut 20 lawns?

   $50.00 + (20 × 0.50) = $60.00
3. After you mow 20 lawns at three dollars per lawn, how much money would you earn?
4. The amount you earned in Step three represents *NO* profit. It does represent what you owe for the lawnmower *and* gas and oil to run it for 20 lawns. These are *costs.* Assume you borrowed the money and must *NOW* pay it *all* back.
5. When do you make a profit?

   Look at Fig. 80-1, Lawnmowing Break-Even Chart. The graph shows you must cut 20 lawns to break even and at this point *no* profit *or* loss is encountered. Beyond 20 lawns, your profit is $2.50 per lawn until you repair or replace the mower. Why $2.50 and not $3.00?
6. Big business begins in much this same way. You will now study the Break-Even Chart, Fig. 80-2, Estimating Profits and Keeping Records, for your newly-formed corporation.

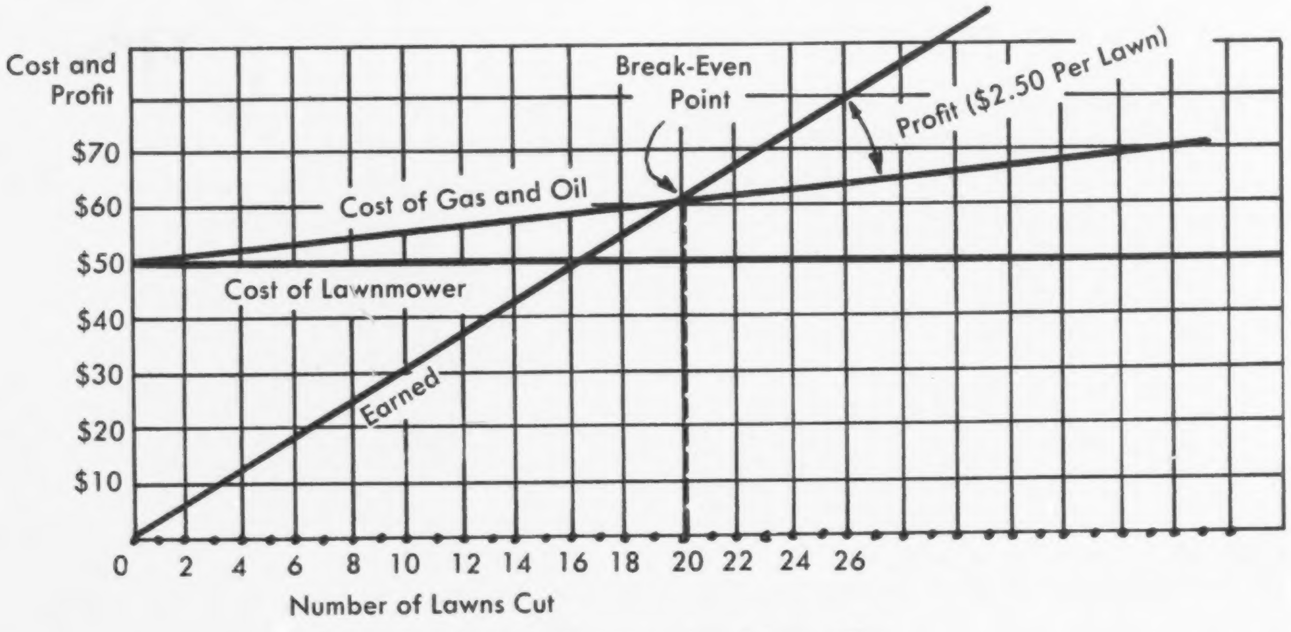


Fig. 80-1. Lawnmowing Break-Even Chart

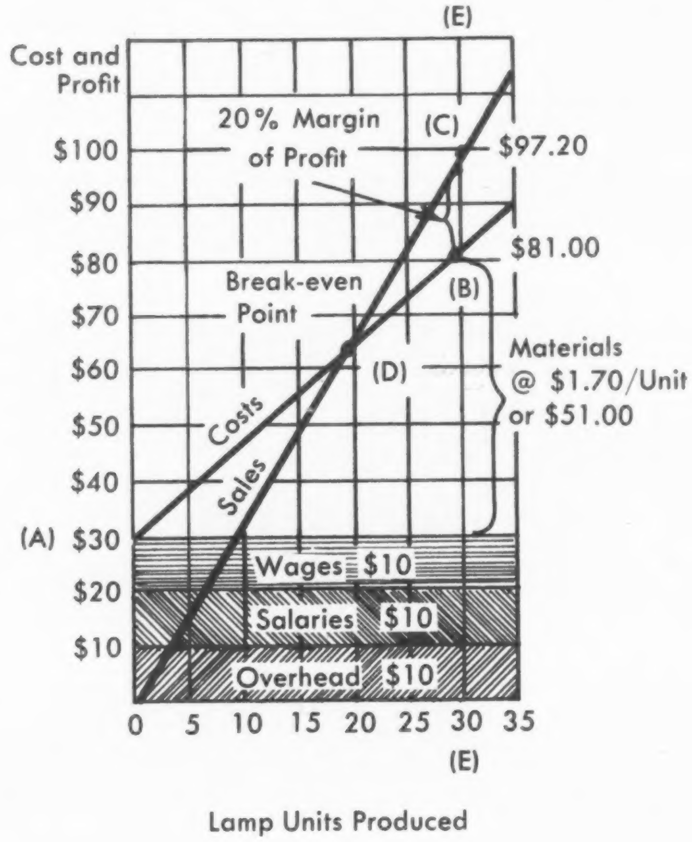


Fig. 80-2. Sample Break-Even Chart

Working the Chart

7. Your teacher will help you study, step-by-step, the way a break-even chart is arrived at. (Have Fig. 80-2 in front of you.) Find each point and line as they are mentioned.
8. On the sample break-even chart there are three *fixed* expenses: *wages, salaries,* and *overhead.* Each of these expenses was found to be $10.00. On the chart find the three shaded strips that run straight across (horizontally). Is the top of the third strip at the $30 mark?

____

9. The company estimated that they would sell 30 lamp units. Along the top of the chart find line E, which shows 30 lamps.
10. Management found that the cost of materials for each lamp unit would be multiplied by the 30 lamps to be produced. The cost of materials was

$______________.

11. Going straight up (vertically) on the line that shows 30 lamp units, the *cost of materials* ($51.00) was added *on top of* the *fixed* expenses. Which point shows $51.00?

Point ______________.

Figuring Cost and Profit

12. To find the "Cost and Profit" line, run your pencil point up this line from zero to $81. Is $81 straight across from point B?

____

13. On the "Cost and Profit" line, the top of the shaded area is labeled point A. Points A and B are connected with a straight line, called line AB. By following this line, the cost of manufacturing any number of lamps from 0 to 35 can be determined.
14. The $81.00 was divided by the number of lamps to be sold, 30. This gives $2.70, the cost per lamp. The $2.70 is the cost of wages, salaries, overhead, and units produced and sold per week. NOTE: The cost per lamp will vary according to the quantity produced per week. It will go up with fewer units, and down as more units are produced.
15. If 30 lamp units are made per week, they cost $2.70 each. The company wanted a 20% profit. (20% is higher than normal profit, and it is used here only as an example.) To find 20% of $2.70, multiply:

$$\begin{array}{r} \$2.70 \\ \times .20 \\ \hline \$\ .5400 \end{array}$$

Profit wanted by the company was $0.54, or 54 cents, on each lamp.

16. Adding *cost* plus *profit* gives a retail, or store, price of $3.24 per lamp.

17. For 30 lamps, the total retail price would be 30 × \$3.24 = \$97.20.
18. This figure, \$97.20, was plotted as point C on the sample chart, directly above point B.
19. The points 0 (zero) and C were then connected with a straight line, called line 0C. This line shows the income from the sale of any number of lamps.
20. The point where lines AB and 0C cross is called the break-even point. Which point is it?

    Point ______.
21. This company will *break-even* when the income from the retail, or store, sales of lamps *equals* the cost of producing the lamps sold. The sample chart shows that 20 lamps retailing at \$3.24 must be sold before the company starts to make a profit. Because this is a short run, the profit increases with each lamp sold *after* the break-even point is reached. It equals 20% per lamp when the last lamp (the 30th) is sold. On a long production run, profit would "level off"; that is, the percent of profit would not increase past 20%, no matter how many lamps were made and sold, as long as the rate of production remained the same.

BALANCE SHEET RECORD FORM

	ASSETS		
Current Assets			
Cash	\$ 8,750.00		
Accounts Receivable	\$14,000.00		
Merchandise Inventory	\$28,200.00		
Store Supplies	\$ 300.00		
Office Supplies	\$ 1,300.00		
TOTAL CURRENT ASSETS		\$52,550.00	
Fixed Assets			
Store Equipment	\$ 8,000.00		
Office Equipment	\$ 3,800.00		
Building	\$12,000.00		
Land	\$ 3,000.00		
TOTAL FIXED ASSETS		\$26,800.00	
Total Assets			\$79,350.00
	LIABILITIES		
Current Liabilities			
Notes Payable	\$ 5,000.00		
Accounts Payable	\$16,350.00		
Taxes Payable	\$ 250.00		
Salaries Payable	\$ 300.00		
TOTAL CURRENT LIABILITIES		\$21,900.00	
Fixed Liabilities			
Mortgage Payable		\$ 5,000.00	
Total Liabilities			\$26,900.00
		CORPORATE WORTH	\$ ______

Fig. 80-3. Balance Sheet Record Form

Problem 2

Objective

Using a *balance sheet,* read how the financial conditions of a company can be determined.

1. Today your teacher will direct a class discussion of a balance sheet. Look at the transparency, Balance Sheet Record Form, in front of you. Find each item as it is mentioned.
2. Follow along with the teacher as the balance sheet entries are described. When through, look at Fig. 80-3, Balance Sheet Record Form, which shows what a completed balance sheet may look like.

Figuring Corporate Worth

3. Figure the Corporate Worth and fill in the blank on Fig. 80-3. Check this answer with your teacher.
4. Answer the questions at the end of this activity.

Questions

1. *Before* production can begin, top management will need very reliable information about the po__________ market for lamps.
2. The *price* of a new lamp should neither be too h__________ nor too l__________ in relation to lamps being sold by other companies.
3. The task of determining what people are *buying,* or have been buying, is one of mar__________ analysis.
4. Statistics about annual *product sales* can be obtained from the gov__________.
5. A *new* corporation must rely heavily on *sales forecast* data to obtain mo__________ for initial capital investments and operating needs.
6. *Materials* on hand and paid for by a company are listed as cu_______ as__________.
7. A *building* owned by a company is listed as a fi_______ as_______.
8. *Salaries owed* to employees are listed as lia__________ on the balance sheet.
9. A bal__________ sh__________ provides financial information.
10. *Taxes* owed are listed as li__________.

ACTIVITY 81

Planning Production Processes

Today you will complete a flowchart of production centers, a process flowchart for the base-bottom center, and a route sheet. You will also examine the relationship between a route sheet and an operation sheet.

Problem 1

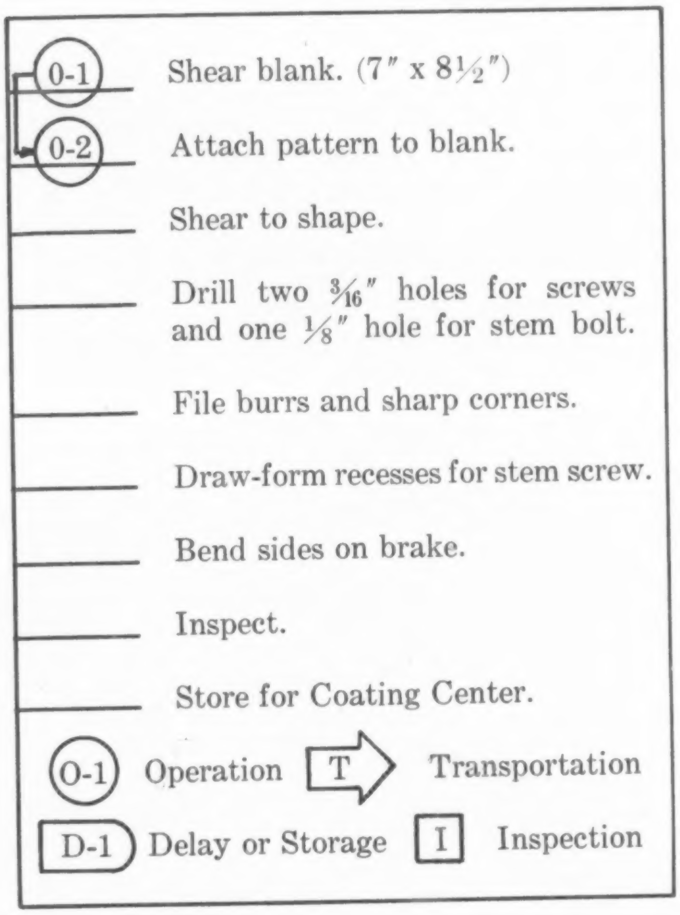
Objective

Using a partially completed flowchart of production centers, draw lines and arrows between centers to show the order in which components and assemblies flow from center to center.

Making a Production Center Flowchart

1. Decide the proper route for production flow and draw a line from production center to production center on the Production Center Flowchart. See Fig. 81-1.

Fig. 81-2. Process Flowchart at Base-Bottom Center



0-1 Shear blank. (7″ x 8½″)

0-2 Attach pattern to blank.

Shear to shape.

Drill two $\frac{3}{16}$″ holes for screws and one ⅛″ hole for stem bolt.

File burrs and sharp corners.

Draw-form recesses for stem screw.

Bend sides on brake.

Inspect.

Store for Coating Center.

O-1 Operation
T Transportation
D-1 Delay or Storage
I Inspection

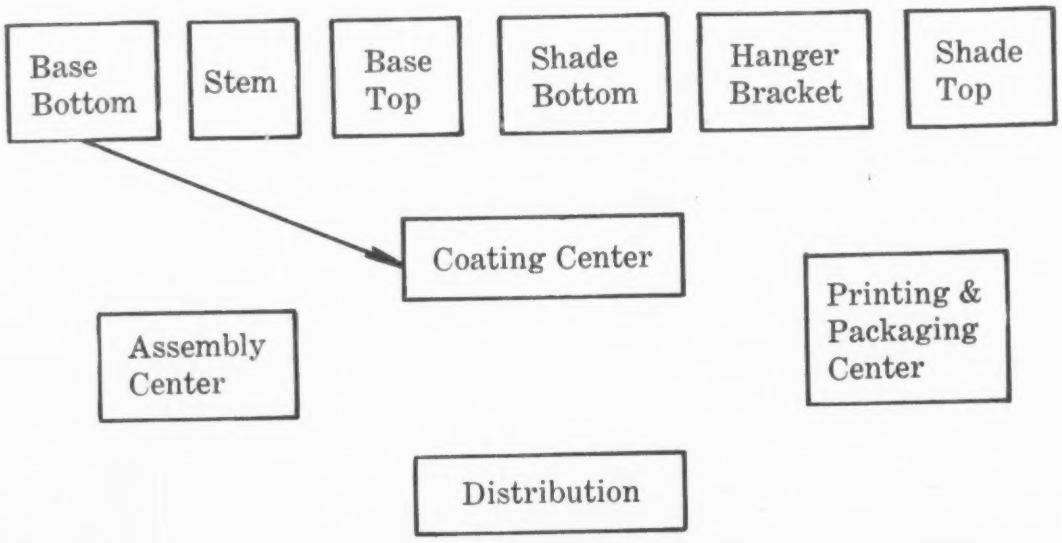

Base Bottom
Stem
Base Top
Shade Bottom
Hanger Bracket
Shade Top
Coating Center
Printing & Packaging Center
Assembly Center
Distribution

Fig. 81-1. Production Center Flowchart

2. Draw an arrowhead at the terminal end of each line to show the direction of the flow of production. An example of the kind of line you are to draw is shown from Base-Bottom Center to Coating Center. See Fig. 81-1.

Problem 2

Objective

Using the partially completed process flowchart for the base bottom, draw the planning symbol for each process listed.

Making Process Flowchart

1. In the process flowchart for the base bottom, draw the proper planning symbol at the left side of each statement describing a process. The first two symbols are drawn for you as an example. See Fig. 81-2.

Problem 3

Objective

Using a partially completed Route Sheet, Fig. 81-3, and the Base-Bottom Process Flowchart, Fig. 81-2, complete the Route Sheet, Fig. 81-3, with a list of processes in proper sequence.

Making Route Sheet

1. Complete the route sheet, writing the processes on the sheet exactly as the processes are listed on the Base-Bottom Process Flowchart, Fig. 81-2.

   Operation No. 4 is filled as an example for you. See Fig. 81-3.

Fig. 81-3. Route Sheet

ROUTE SHEET

Production Center 6

Part Name Base Bottom Part No. 1 Begin at Fabrication Dept.

Number of Pieces Needed ______ Material 20-22 ga. black iron End at Coating Dept.

Operation Number	Description of Operations	Machine	Tools, Jigs
1		Metal shear	
2			
3		Metal shear	Bevel gage
4	Drill two $\frac{3}{16}$″ holes for screws and one $\frac{1}{8}$″ hole for stem bolt.	Power hand drill	Drill jig, $\frac{3}{16}$″ and $\frac{1}{8}$″ twist drills
5			File
6			Punch and die jig
7		Pan brake	
INS			
8			

Problem 4

Objective

Using a completed Route Sheet, Fig. 81-3, note that operation process No. 4 contains a title for the operations listed in detail on the Base-Bottom Drilling Operation Sheet, Fig. 81-4.

Checking an Operation Sheet

1. Refer to the Base-Bottom Route Sheet and note that operation process No. 4 is "Drill two 3/16″ holes for screws and one 1/8″ hole for stem bolt." See Fig. 81-3.
2. Now turn to Base-Bottom Drilling Operation Sheet. See Fig. 81-4.
3. The entire operation sheet describes the steps necessary to accomplish the process listed in No. 4 in the Route Sheet. See Fig. 81-3.
4. Place an X beside the operation item that best describes the purpose of this operation sheet.

Fig. 81-4. Operation Sheet

Part No.: 1 **Name:** Base Bottom

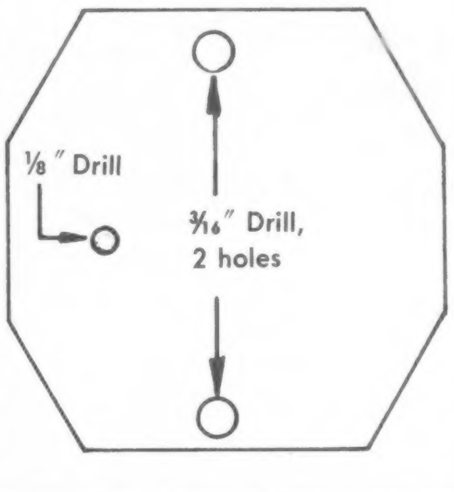
Operations to Be Performed: Drilling and filing

Machine: Drill press

Work Station: Drilling #1

Tools: 1/8″ and 3/16″ twist drill, chuck key, C-clamp, smooth file

Jigs and Fixtures: Base Bottom drill fixture, and drill template



ITEM	OPERATION ROUTINE
1.	Place twist drill into drill chuck. Tighten with chuck key.
2.	Place fixture on drill press table. Align hole.
3.	Clamp fixture to drill press table.
4.	Place five production blanks into fixture.
5.	Place template into fixture.
6.	Clamp template and production blanks in fixture.
7.	Drill two holes 3/16″, two locations, and one 1/8″ hole.
8.	Remove C-clamp from template and production blanks.
9.	Remove production blanks and file burrs from holes.
10.	Inspect.
11.	Repeat Steps 4 through 10 until all pieces are drilled.
12.	Remove fixture from drill press. Clean up work station.

ACTIVITY 82

Establishing Production and Quality Control

Today you will use inspection templates and inspection gages to inspect lamp components.

Problem 1

Objective

Using a base-bottom and shade-top inspection template, decide whether the component blanks are drilled and sheared to shape within acceptable standards.

Equipment (Group of 5)

1	base-bottom inspection template
1	shade-top inspection template

Supplies (Group of 5)

1	acceptable flat base-bottom component
1	defective flat base-bottom component

Using a Template to Inspect the Base Bottom and Shade Top

1. Place the base-bottom inspection template on a flat lamp-base component. See Fig. 82-1.
2. Holes and outside shape must line up. See Fig. 82-2.
3. Hole locations are critical. Outside shape may vary somewhat, but not greatly. See Fig. 82-3. One of your components is acceptable. The other is a reject.
4. Inspect the components and record the results in the space provided in your Laboratory Manual. See Figs. 82-6 and 82-7.

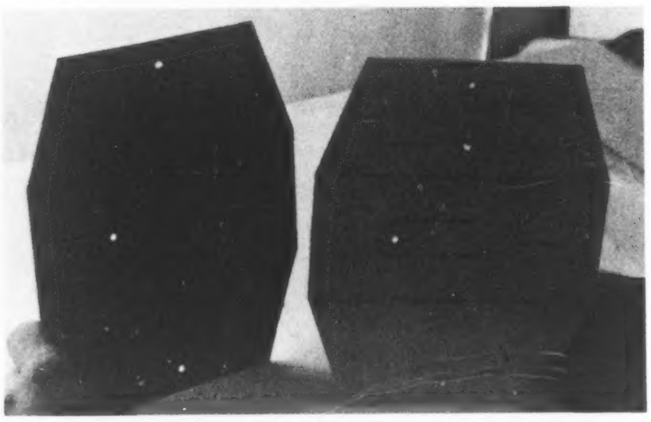


Fig. 82-1. Preparing to Check the Accuracy of the Component Part with the Template of that Part.

What kinds of questions must the student ask himself to determine acceptance or rejection of the parts?

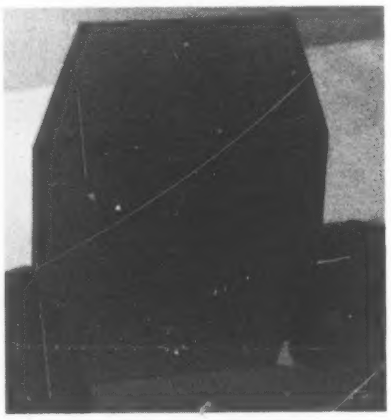


Fig. 8[illegible] Correct Matching Between the Template and the Component

Notice how the holes line up. Also, no metal is exposed beyond the dimension of the template.

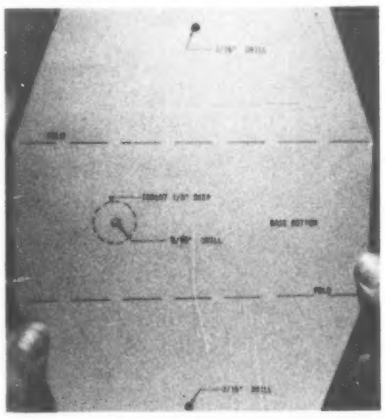


Fig. 82-3. Incorrect Fit

Notice how the holes in the component do not line up, nor has the metal been cut correctly. This piece would have to be rejected.

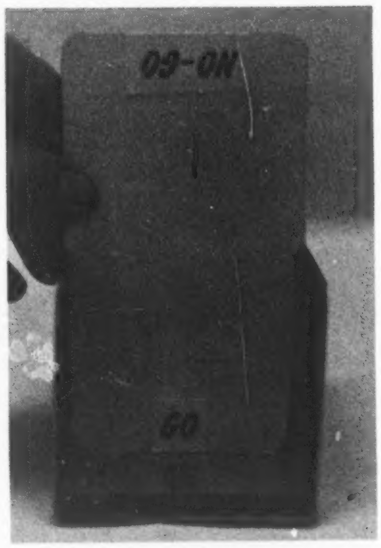


Fig. 82-4. "Go" End of the Gage Fits into the Base Bottom
If it did not, would the base be acceptable?

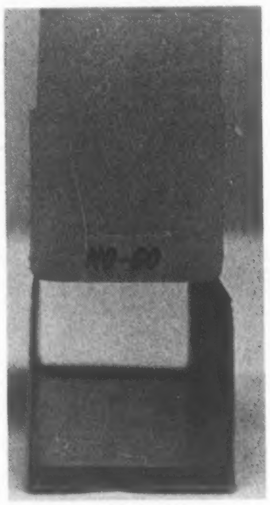


Fig. 82-5. No-Go Gage Does Not Fit
Is the base acceptable?

Problem 2

Objective

Using a base-bottom and shade-top inspection gage, decide whether two lamp base bottoms are formed to shape within acceptable standards.

Equipment (Group of 5)
1 base-bottom inspection gage
1 shade-top inspection gage

	ACCEPT	REJECT	ACCEPT	REJECT
Base bottom, flat	Part #		Part #	
Shade top, flat	Part #		Part #	
Base bottom, formed	Part #		Part #	
Shade top, formed	Part #		Part #	

Fig. 82-6. Inspection Schedule

	ACCEPT	REJECT	ACCEPT	REJECT
Base bottom, flat	Part #		Part #	
Shade top, flat	Part #1		Part #2	
	✓			✓
Base bottom, formed	Part #		Part #	
Shade top, formed	Part #		Part #	

Fig. 82-7. Example
The lamp shade top #1 is acceptable. Part #2 is checked in the "reject" column.

Supplies (Group of 5)
1 acceptable formed base-bottom component
1 defective formed base-bottom component
1 acceptable shade-top component
1 defective shade-top component

Using the Go-No-Go Gage

1. Insert the smaller dimension (the part of the gage that reads "go") of the go-no-go

gage across the inside of the base bottom. Keep one edge of the gage tight against the same side of the formed base bottom. The inside dimension across the base bottom must not be smaller than the smaller dimension of the gage. See Fig. 82-4.

2. Try the no-go end of the gage in the base bottom. The gage should *not* fit. See Fig. 82-5.
3. In the inspection column for the base bottom, Fig. 82-6, record the component part number and check under "accept" or "reject."
4. Using the go-no-go gage for the shade top, use the same procedures and record your results on the inspection schedule.

Questions

1. You may wish to ask the teacher for the numbers of the parts that should have passed inspection.

ACTIVITY 83A-P

Making and Combining Components and Assemblies

The class will manufacture components and assemble lamps in continuous production until the order is completed. Activities will continue day-by-day for about three weeks.

Problem

Objective

Using the proper equipment and supplies, manufacture enough components so that when assembled each student will have a completed lamp in a package.

> **Precaution**
>
> Two or three additional completed lamps should be made to be sure that all class members will receive a good product.

Organizing for Production

1. Each group will be assigned a component to manufacture. Your teacher will determine group size and outline the system of production you are to follow.
2. Each group must have an Instruction Panel consisting of step-by-step pictures of the operations to be completed by the group, a Route Sheet, and an Operation Sheet, where needed.
3. The Route Sheet lists the tools needed for the operations and outlines the operations in the order that must be followed in manufacture.
4. The Production Process Flowchart specifies production centers and the flow of work for the entire manufacturing process from components to final assembly, including packaging and distribution. Check the chart to see where your group may be assigned to succeeding steps in production after the beginning phases are completed.
5. At the completion of this unit enough lamps should have been manufactured so that there will be one for each member of the corporation or for each stockholder.
6. As a member of the work force producing the desk lamp, you will work only on certain components of the lamp. Other members of the work force will work on other components. Therefore, *quality control* will be an important part of this activity. Since the components will be assembled later in the production run, each of you should do your best on your job to make sure the completed components will fit to produce a good product.
7. Refer to the Instruction Panels for step-by-step procedures on the component that your group is working on. The panels are designed to make your work go smoother. *Use the panels from the beginning of fabrication to the final packaging.*

   Below is a list of panels and their numbers.

Names of Instruction Panels

1. Shade-Top Production Center
2. Shade-Bottom Production Center
3. Hanger Bracket Production Center
4. Stem Production Center
5. Base-Top Production Center
6. Base-Bottom Production Center
7. Vinyl Coating Production Center
8. Dip and Spray-Paint Production Center
9. Assembly Production Center
10. Service Manual Production Center
11. Package Fabrication Production Center

Special Duties

Foreman:

a. Obtain and return the Instruction Panel.

b. Check and report on work performance.

Recorder:

a. Fill out and maintain Production Center Assignments in his own Laboratory Manual. See Fig. 83A-P-1.

b. Check Student Work Report in the Laboratory Manual of each student in his group daily. See Fig. 83A-P-2.

Equipment Supervisor:

a. Obtain and return special tools as required.

b. Report any special problems concerning equipment.

Timekeeper:

a. Report any duties not performed on time.

Safety Supervisor:

a. Report to the teacher any unsafe conditions with tools or machines.

b. Report to the teacher any dangerous conditions caused by students, such as not wearing safety glasses, or misuse of tools or machines.

All Students:

a. Clean manufacturing center where you are working.

b. Return all equipment, supplies, and lamp components to the proper storage area.

Fig. 83A-P-1. Production Center Assignments

Class Number ____________ Production Center Number ____________

Operation	Student Name	The Job Assigned
	Special Duties	

Fig. 83A-P-2. Student Work Report

Work Day	Kind of Work Done (Include Special Duties)	Number of Pieces Completed
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Fig. 83A-P-3. Inventory Control Chart

Production Center Inventory Control Student	Units		Units		Units		Units	
	Start	Complete	Start	Complete	Start	Complete	Start	Complete
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

NOTE to inventory control student: You may deliver parts for each subassembly as a unit in a paper bag to workers in your center. The number of completed units should be recorded on the inventory control chart.

ACTIVITY 84

Establishing Production and Quality Control

Today you will be reassigned to jobs as needed and continue production of the lamp.

Problem

Objective

Using assignments and job instructions, continue production of the lamp.

Combining Subassemblies

1. Production now involves subassemblies and final assembly of the lamp. Follow the instructions of the teacher for assignments and continue production.
2. You may also be asked to answer the questions in the Laboratory Manual.

Safety

a. Wear safety goggles in the work areas.
b. Follow the safety precautions outlined by the teacher.

Questions

1. What control insures that production will take place in an efficient way and at the right time?

   ____

2. What is the main practice we use in quality control?

   ____

3. Does random sampling require inspection of every part?

   ______ Yes ______ No

4. What do we call the range of difference in size from the specified exact size that is allowed?

   to ________________.

5. What do we call the kind of testing that must damage a product?

   de ____________.

ACTIVITY 85

Arranging for Distribution and Sales

Problem 1

Objective

Using the assignment to fabricate boxes for packaging the lamp, use the Laboratory Manual directions *and* Route Sheet 85-15.

Equipment (Group of 5)

1	24″ bench rule
1	15″ paper cutter
1	screen-stencil frame and stencil
1	6″ scissors
1	rubber squeegee
1 ea.	templates for top and bottom
1	tape-cutting jig
2	wooden blocks, 1½″ x 1½″ x 15″
1	stapler

Supplies (Class)

10 ft.	masking tape *or* gummed paper tape, 2″ wide
50 shts.	.030-gage, 14″ x 22″ chipboard *or* equivalent in oak tag, etc.
1 qt.	silk-screen paint, color selected by class
1 ball	string, optional

General Instructions

1. *Manpower Needs*
   Workers: 5
   Days: 3
   Manpower days: 15
2. Obtain your equipment and supplies. Refer to the Route Sheet, Fig. 85-15, for review of procedure.
3. Lay out your package tops and bottoms on chipboard, posterboard, or oak tag using a template. Do *not* mix tops and bottoms. See Fig. 85-1. Mark the slits carefully with a pencil. See Fig. 85-3.
4. Cut the slits with scissors or utility knife. See Fig. 85-15.

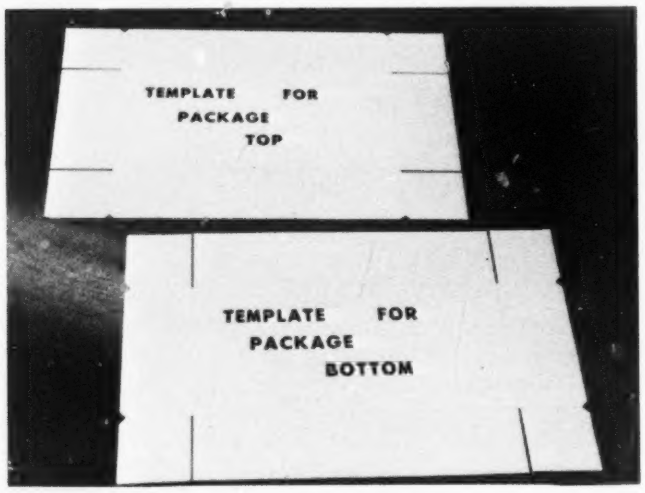


Fig. 85-1. Package Templates

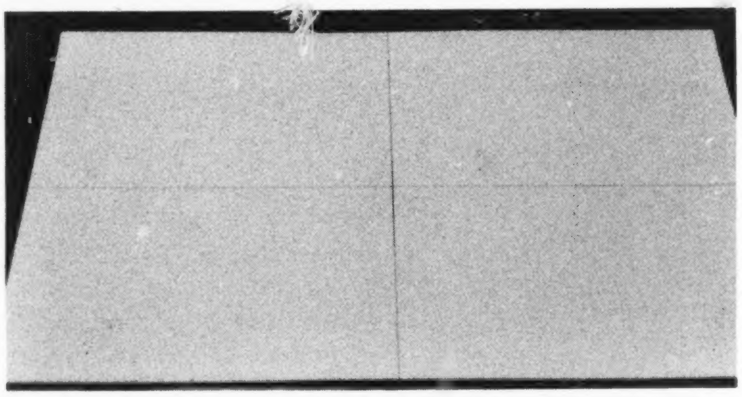


Fig. 85-2. Cardboard Marked into Quarters

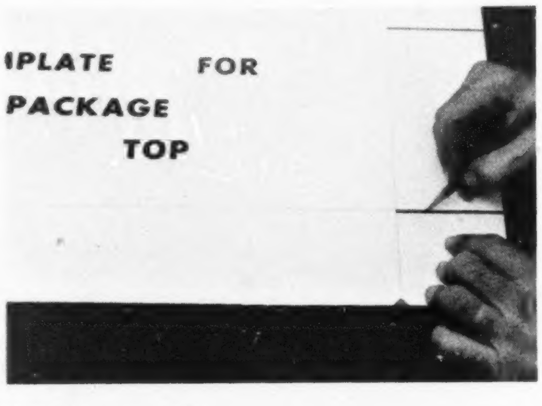


Fig. 85-3. Marking Slits

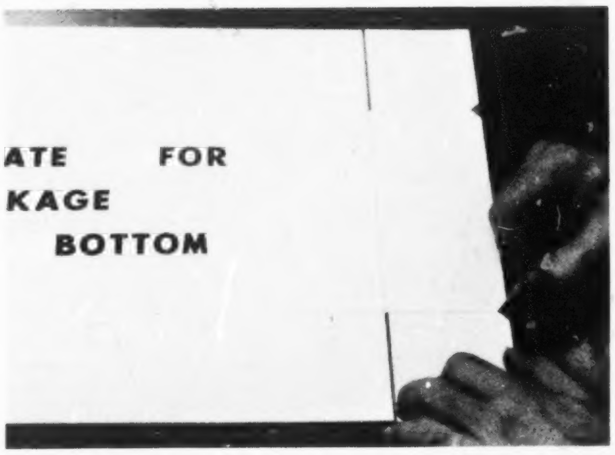


Fig. 85-4. Marking Notches

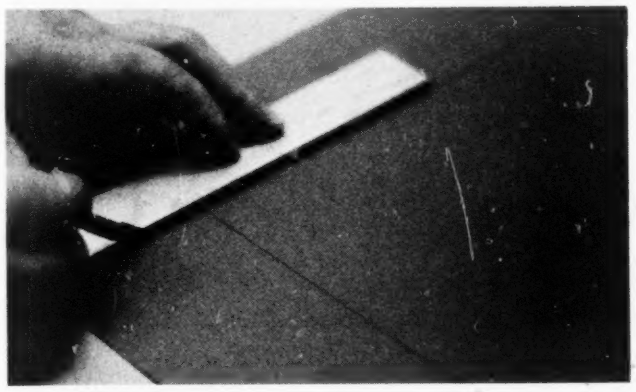


Fig. 85-5. Cutting Slits

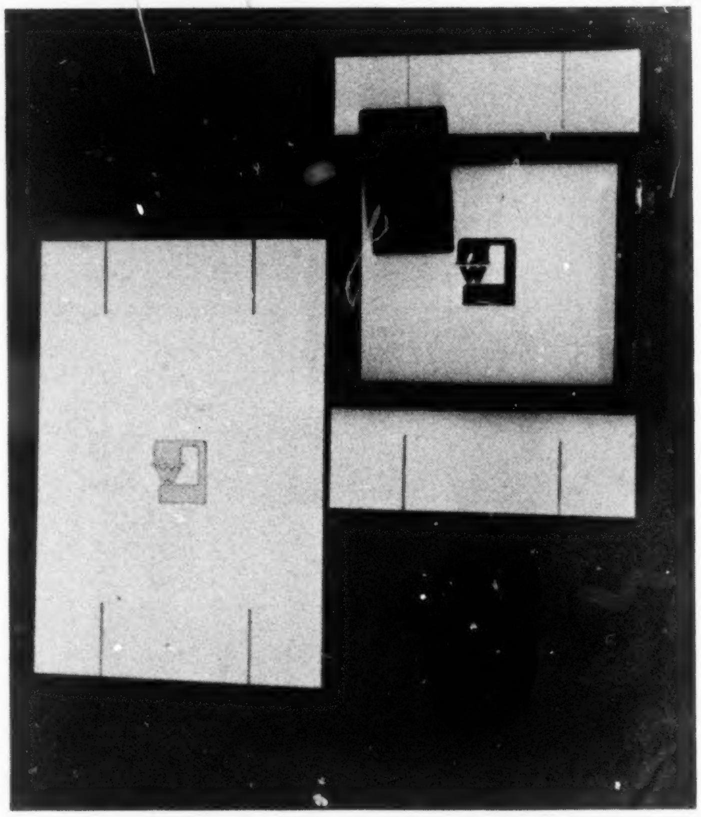


Fig. 85-6. Stenciling Design

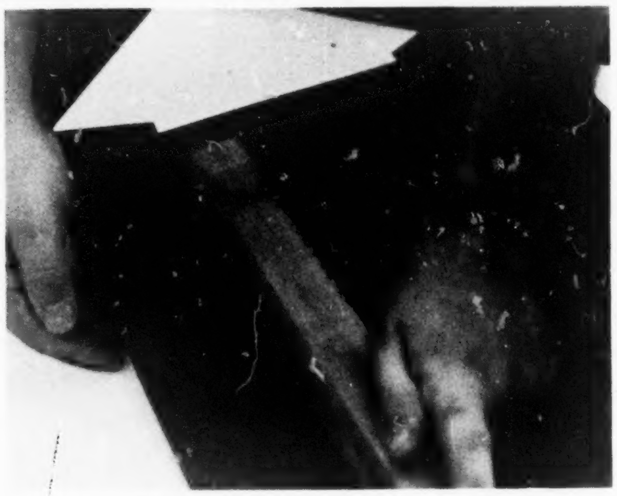


Fig. 85-7. Bending Folds

Fig. 85-8. Stapling

5. Screen-stencil your company's trademark, etc., on all the pieces that will be used as *tops*. Use the same stencil as for the cover of the Service Manual. See Fig. 85-6. Development of the design is covered in Problem 2 of the Service Manual.
6. Fold the sides of each piece using a straight piece of wood. See Fig. 85-7.
7. Staple the end tabs using two staples per tab. Tabs may be secured with masking tape if desired. See Fig. 85-8.
8. Store the packages until they are needed.
9. NOTE: Later, after the product and Service Manual are placed in the package for distribution, (see Fig. 85-9), tape the edge of the top to the base of the bottom. See Fig. 85-10. An alternate way to keep the lid closed is to use string to tie it closed securely. Your teacher will tell you which method to use.

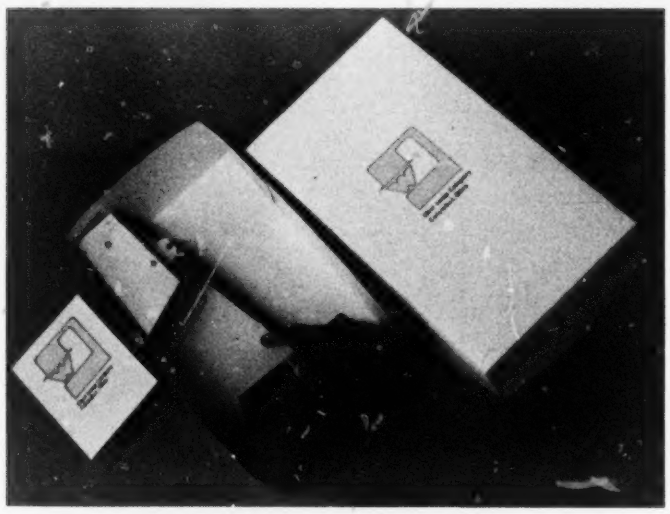


Fig. 85-9. Packaged Lamp

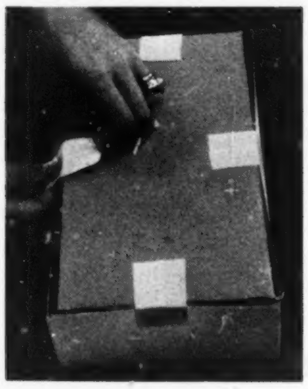


Fig. 85-10. Taping Box

Problem 2

Objective

Given the assignment of preparing a Service Manual for the lamp product, use the following directions and Route Sheet 85-15.

Equipment (Group of 5)

1	12″ rule
1	spirit duplicator
1	X-acto® knife
1	stapler
1	15″ paper cutter
1	screen-stencil frame
1	rubber squeegee
	several service manuals for various products
1	6″ scissors

Supplies (Group of 5)

50 shts.	duplicator paper
1 roll	masking tape
12 shts.	plain paper for sketching
2–4	spirit masters
1–2 pc.	lacquer-base stencil film
25 shts.	colored construction paper 5½″ x 8½″
6 shts.	tracing paper
1 qt.	silk-screen paint in Problem 1

General Instructions

Manpower Needs

Workers: 5

Days: 4

Manpower days: 20

NOTE: Refer to Fig. 85-15, Route Sheet for the Service Manual, for brief instructions.

Cover

1. Design an attractive front cover for the Service Manual. Include the *name* of the *corporation*, the *product name* and *model number*, and a monogram or *trademark*. Add other design features according to your *own* ideas.
2. The cover design will be printed by a screen-stencil process. Therefore your final design should use *block lettering* and art work that can be cut into stencil film *easily*.

General Instructions Part 1

1. The pages you write and design will be printed in booklet form for lamp customers. Figures 85-12 and 85-13 show how a sheet of paper will be folded to make an eight-page booklet and how it will be covered.
2. The finished booklet size will be trimmed to 4″ x 5″. Be certain to keep your designs within this space. See Fig. 85-11.
3. Obtain plain paper and tracing paper so that you can sketch or write rough ideas and develop your best ones.
4. There are seven designs and writing tasks to be completed before masters are prepared. *Instructions for these seven tasks follow.*

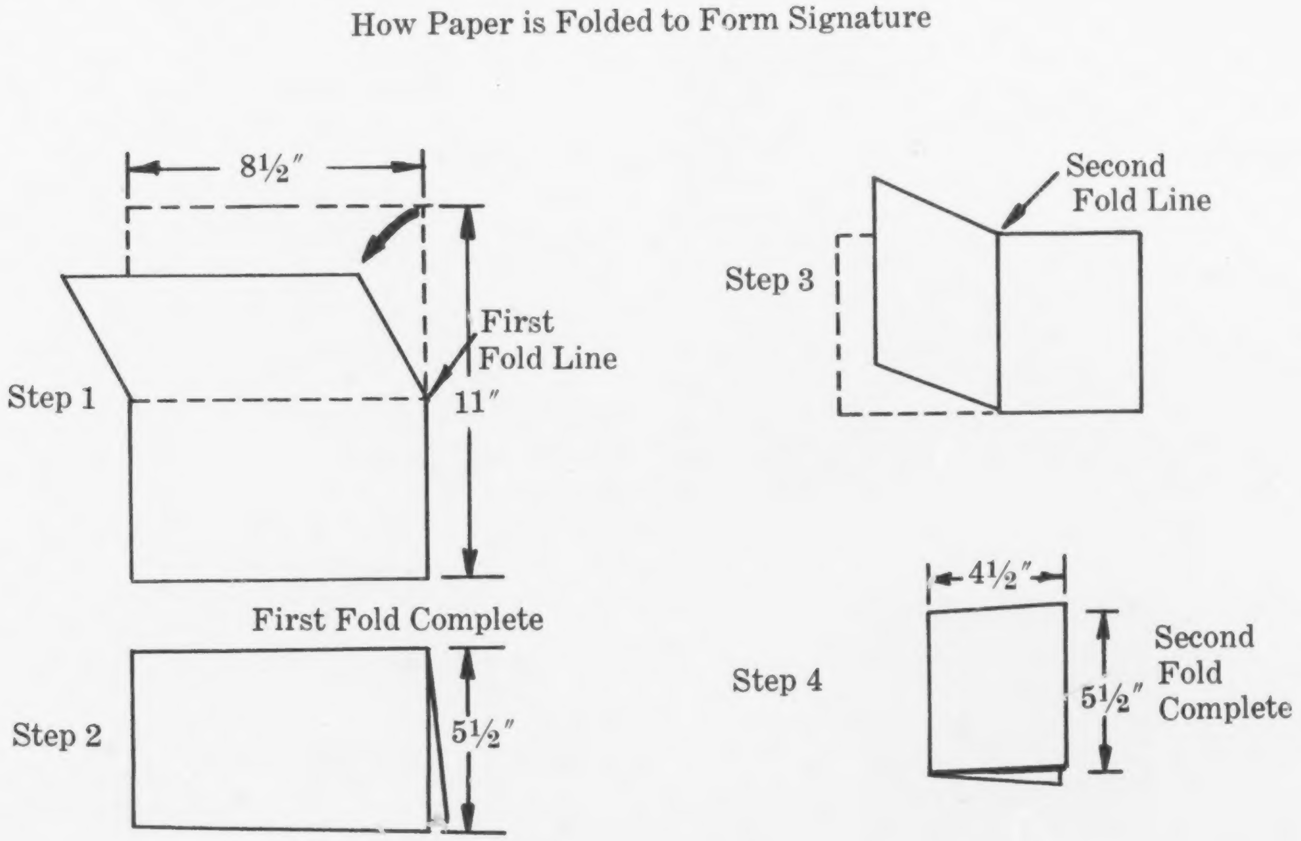

How Paper is Folded to Form Signature
8½″
First Fold Line
Step 1
11″
First Fold Complete
Step 2
5½″
Second Fold Line
Step 3
4½″
Step 4
5½″
Second Fold Complete

Fig. 85-11. Service Manual

Title Page

1. Write a *page 1* that *includes* the following:
   a. Name of product
   b. Model number, IACP 103
   c. Name and address of manufacturer
2. Refine a page design giving this information. *Include* a border design, a trademark, or other suitable material. Use two colors in your trademark. One is the color of construction paper you select, the other is the color of silk-screen paint you select, such as yellow paint on blue paper.

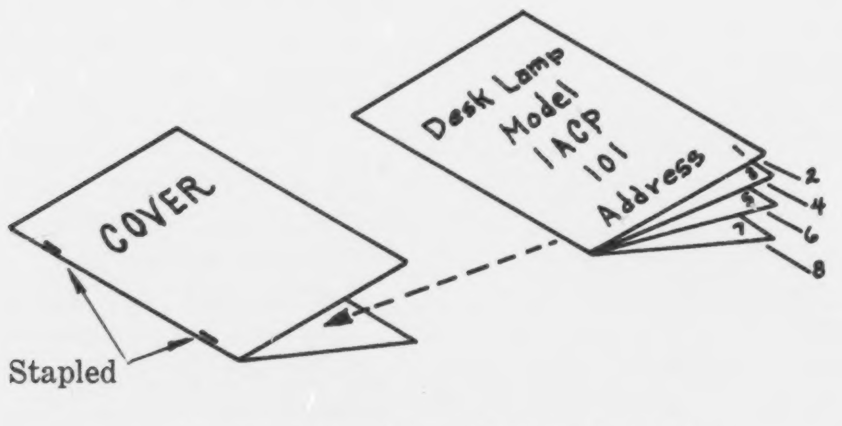
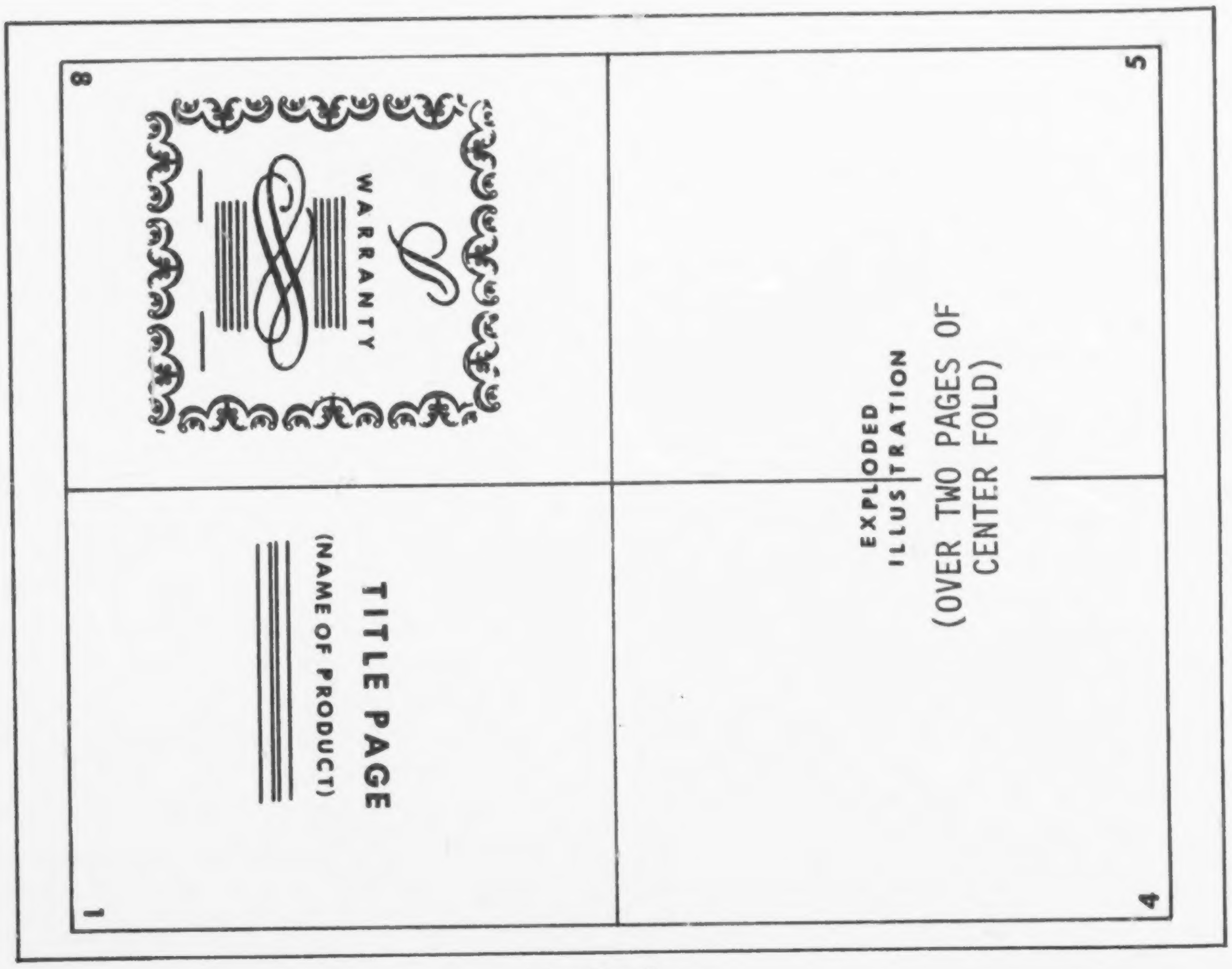
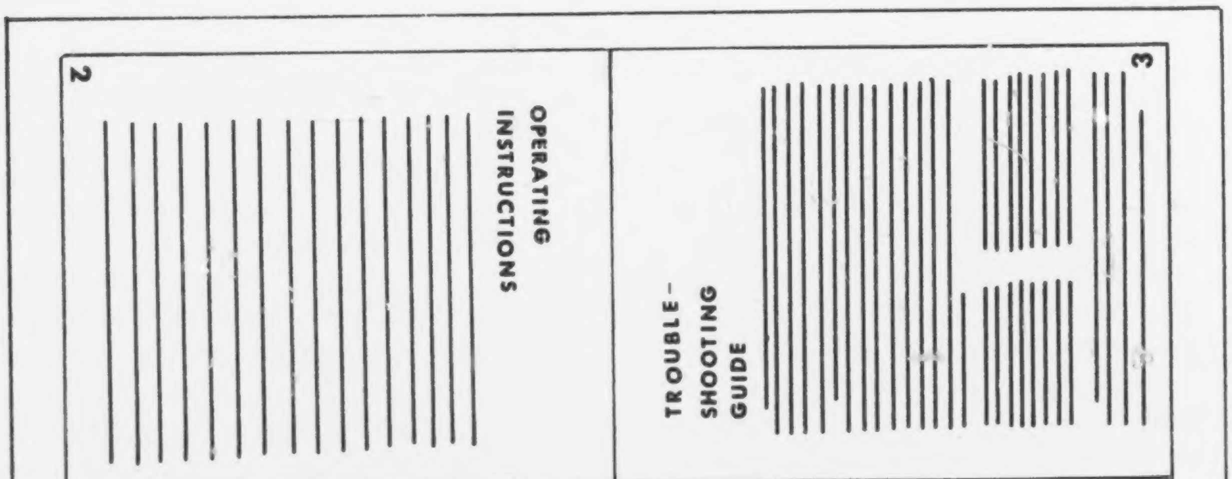

COVER
Stapled
Desk Lamp
Model
IACP
101
Address
1
2
3
4
5
6
7
8

Fig. 85-12. How Manual Will Be Covered


8
WARRANTY
TITLE PAGE
(NAME OF PRODUCT)
1
5
EXPLODED ILLUSTRATION
(OVER TWO PAGES OF CENTER FOLD)
4

Top Surface


2
OPERATING INSTRUCTIONS
TROUBLE-SHOOTING GUIDE
3
7
PARTS LIST (CONTINUED)
PARTS LIST
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
6

Bottom Surface

Fig. 85-13. Service Manual

Fig. 85-14. Checklist for Cause of Failure

Part	Method of Examination
Bulb	Inspect visually. *Do not touch hot bulb.*
Socket	UNPLUG LAMP. Remove shade top. Remove metal socket case and fiber insulator. Check to see if wires are secured to screw posts.
Switch	UNPLUG LAMP. Remove two screws from base bottom. Pull base top piece free from bottom piece. Check wire nuts that secure switch wires to lamp cord.
Plug	UNPLUG LAMP. Open plug and check for evidence of short circuit.
Cord	UNPLUG LAMP. Look for frayed insulation or abrasions.

Operating Instructions

1. Write a *page 2* that *includes* the following general information:
    a. Voltage on which the lamp operates (115V).
    b. Bulb size and type (40W high-intensity).
    c. A caution not to touch the bulb when the lamp is lit, or remove a hot, burned-out bulb.
    d. Instructions for adjusting the shade.
    e. Suggestions for using the lamp.
2. Lay out the page so the information will fit inside a 4″ x 5″ space.
3. Your teacher will furnish a master for printing the exploded drawing for *pages 4 and 5.*

Parts List

1. If your class completed ACTIVITY 78B, each of you will have a list of lamp parts in your Laboratory Manual. Compare lists carefully and choose one that is correct.
2. Decide how to fit the list in two 4″ x 5″ sheets, *pages 6 and 7.*

Warranty Page

1. You are to write a warranty or guarantee for the desk lamp. Study warranties in sample service manuals for class.
2. Write samples of warranty paragraphs, and decide which statements to use. Include a line for recording the serial number.
3. Fit the information into a 4″ x 5″ space, for *page 8.*

Troubleshooting

1. Lamp customers will need to know how to look for possible sources of trouble if a desk lamp stops working. Study Fig. 85-14, which gives information in the form of a table.
2. Design a *page 3.* Reword the instructions in any way that will make them more helpful.
3. Fit the information into a 4″ x 5″ space.

General Instructions Part 2

1. When you have completed all designs and written information on separate pages for the Service Manual, arrange the sheets as shown in Fig. 85-12. The group foreman is to check these plans.
2. Instructions for three sets of manufacturing tasks follow.

Procedure for Spirit Duplicating

1. Divide each spirit master into fourths and remove the thin cushion sheet.
2. Using Fig. 85-13 as a guide, transfer all the drawings and written information to the spirit masters.
3. When both masters have been prepared, make duplicates with the spirit duplicator. Print both sides of pages. Be sure the pages are fed into the duplicator correctly for the second printing.
4. Store the signatures to allow them to dry.
5. Fold the signatures as shown in Figs. 85-11 and 85-12.

Procedure for Screen-Stencil Printing

1. Transfer the cover design to the stencil

film. Trace the design with the tracing paper upside down on the film.

2. Cut the cover design into the stencil film.
3. Fasten the design stencil to the screen. Check the stencil to make sure it adheres securely to the screen.
4. Have the teacher check the setup before printing.
5. Make a test run to check the quality of the stencil. Make any adjustments necessary before beginning printing. Print the covers.
6. After the ink is dry, fold the covers in half.

Procedure for Completing Manufacture

1. Collate the cover and signature as shown in Fig. 85-11.
2. Staple at the fold.
3. Trim all edges except the stapled fold, using the paper cutter. The finished size of the manual should be 4" x 5".
4. Store the manuals.

Fig. 85-15. Route Sheet for the Service Manual

Production Center ______________

Part Name Service Manual Part No. ______________ Begin at ______________ Dept.

Number of Pieces Needed ______________ Material ______________ End at ______________ Dept.

Operation Number	Description of Operations	Machine	Tools, Jigs
1.	Prepare designs and information for manual.		
2.	Prepare cover design.		
3.	Transfer designs and information to spirit-duplicating masters.		
4.	Duplicate: print sheets on both sides.	Duplicator	
5.	Fold signatures.		
6.	Transfer cover design to screen stencil.		
7.	Shear stencil.		Knife
8.	Attach stencil to screen and print covers.	Screen-stencil frame	
9.	Fold covers.		
10.	Collate.		
11.	Staple.		Stapler
12.	Trim.		Scissors

ACTIVITY 86

Arranging for Distribution and Sales

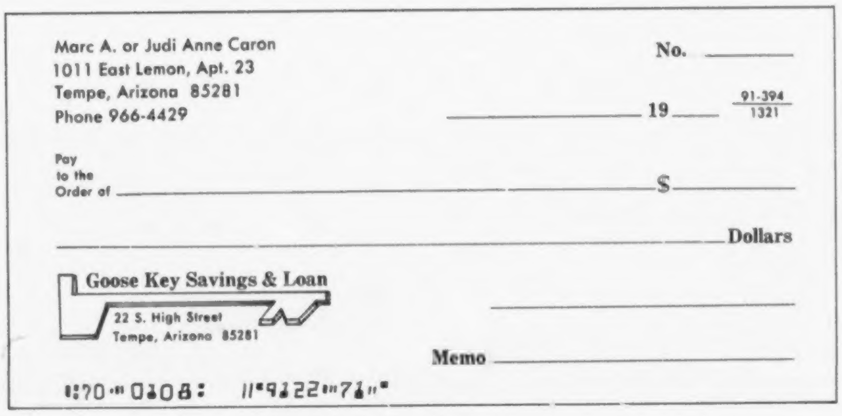
Problem 1

Objective

Using a blank check, understand the mechanics of writing a check and purchase a manufactured product, your desk lamp.

Understanding a Check

1. Refer to Fig. 86-1 and look at the blank check and canceled personal check, both sides.



Marc A. or Judi Anne Caron
1011 East Lemon, Apt. 23
Tempe, Arizona 85281
Phone 966-4429

No. ______

______ 19___ 91-394/1321

Pay to the Order of ______ $______

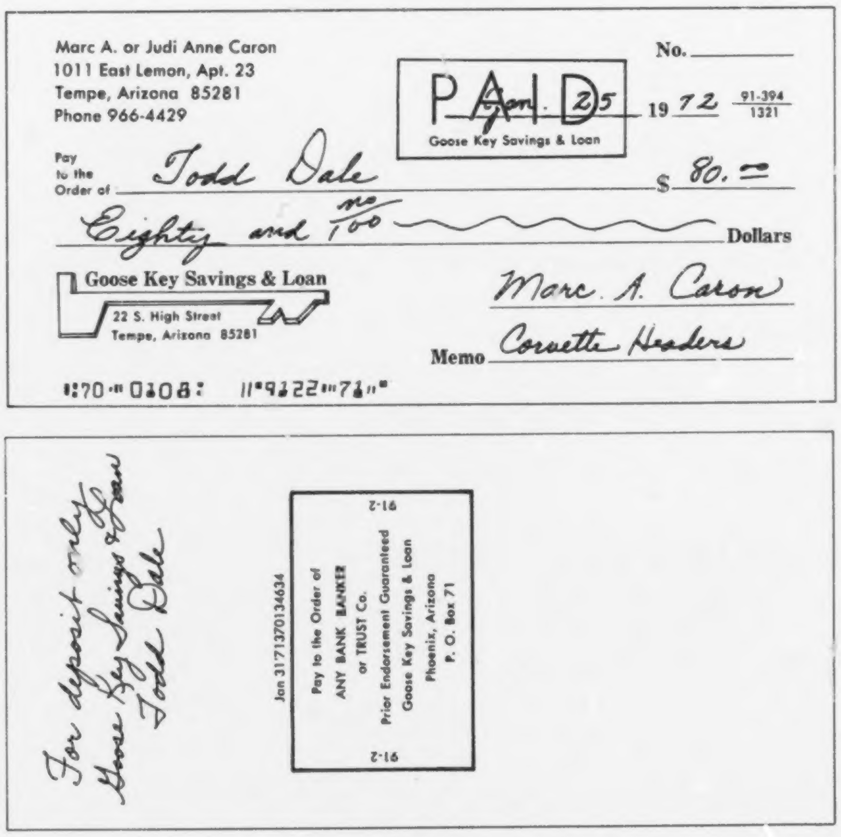
______ Dollars

Goose Key Savings & Loan
22 S. High Street
Tempe, Arizona 85281

Memo ______

⑆70⑈0108⑆ ⑈9122⑈71⑈

A. Blank Check



Marc A. or Judi Anne Caron
1011 East Lemon, Apt. 23
Tempe, Arizona 85281
Phone 966-4429

No. ______

PAID
Goose Key Savings & Loan

Apr. 25 19 72 91-394/1321

Pay to the Order of Todd Dale $ 80.00

Eighty and no/100 Dollars

Goose Key Savings & Loan
22 S. High Street
Tempe, Arizona 85281

Marc A. Caron

Memo Corvette Headers

⑆70⑈0108⑆ ⑈9122⑈71⑈

For deposit only
Goose Key Savings & Loan
Todd Dale

91-2
Jan 31'71 370134634
Pay to the Order of
ANY BANK BANKER
or TRUST Co.
Prior Endorsement Guaranteed
Goose Key Savings & Loan
Phoenix, Arizona
P. O. Box 71
91-2

B. Cancelled Personal Check

Fig. 86-1

2. You will recall from the transparency presentation what the numerals, etc. mean on the check. Note how it is filled out and signed on the front. Your signature is your own personal identification. Sign your check as your name appears on all legal documents, such as a birth certificate.
3. On the back of the check there is the *endorsement*, the signature or rubber stamp of the person to whom the check is paid. When it clears the bank, the bank stamps the front as "paid."

Purchase of Manufactured Products

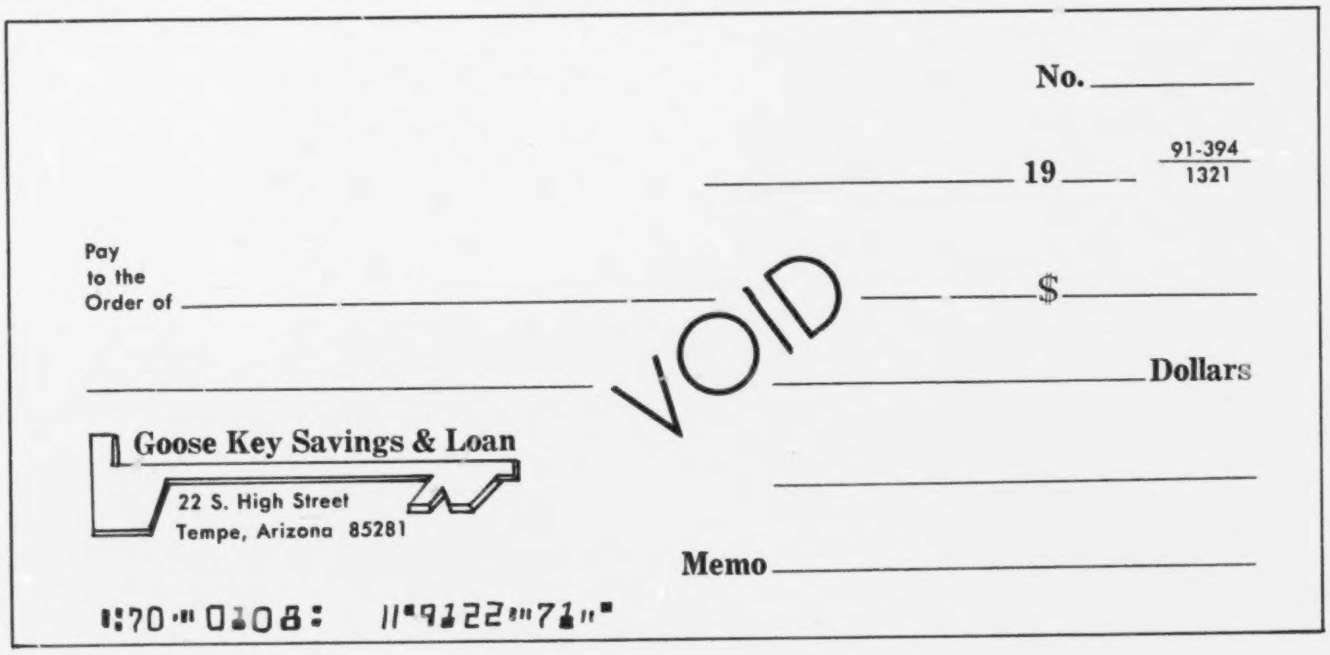
4. Today you will "purchase" the product manufactured by your corporation, the desk lamp.
5. Fill in the blank check, Fig. 86-2, as follows:
   a. Assume that this check is the number *869*.
   b. Pay to the Order of: *your corporation name*.
   c. Amount: *$4.75, Four and 75/100* or *75/XXX*.
   d. Sign *your name*.
   e. The word *VOID* should appear across the face of the check so that no one will mistake it for a real check.
6. Cut out the check and give your check to the *Vice-President of Finance*. He should add them up, as in Step 7.
7. As a class, help determine the *total* amount of *retail* sales receipts:

   $4.75 × number of lamps sold = retail sales.
8. On Fig. 86-3 enter this amount as "Cash," the *top* line.
9. You will pick up your product at a warehouse area designated by your teacher, at the *end* of the period.

Problem 2

Objective

In closing out your business, take *inventory* of unused materials and supplies.



No. ______

______ 19__ 91-394/1321

Pay to the Order of ______ $______

______ **Dollars**

Goose Key Savings & Loan
22 S. High Street
Tempe, Arizona 85281

______

Memo ______

⑆70⑈0108⑆ ⑈9122⑈71⑈

VOID

Fig. 86-2. Blank Check

Fig. 86-3. Current Assets

Cash (lamps sold, retail)	$________
Merchandise Inventory	$________
Materials Inventory	$________

Taking Inventory

1. Any complete lamps leftover are to be sold to a "wholesaler" (the teacher) for $4.00 each. Determine this amount:

   $4.00 x number of lamps leftover.
2. On Fig. 86-3 enter this amount as "Merchandise Inventory," line 2.
3. Now meet with your regular group of five.
4. You are to take inventory using leftover items listed in Fig. 86-4.
5. The *unused* materials are to be sold back to the supplier or the school. This amount is credited to the corporation as an asset.
6. Determine the *total value* of items inventoried in Fig. 86-4. Enter this amount on Fig. 86-3, line 3, as "Materials Inventory."
7. Check your answer for the *Total Value* within your group. Then the *foreman* should check with the teacher for the correct answer. Be sure it is recorded in Fig. 86-3, line 3.
8. Put away your Laboratory Manuals and be seated.

Fig. 86-4. Inventory and Accounting Sheet

Quantity	Description	Unit Value	Total Value
1 can	Spray paint	$ 1.09	
22	Wing nuts	$ .04 each	
5	Plugs	$ .12 each	
100 ft.	Lamp wire	$ .02¼ ft.	
10	Socket	$ .36 each	
200	Pop rivet	$ .01¼ each	
½ roll	Contact vinyl	$15.00 roll	
9	Rotary switch	$ .27 each	
25	Wire nut	$ .01 each	
6 lbs.	Scrap metal	$ .15 lb.	

Total Value $__________

ACTIVITY 87

Liquidating the Corporation

Today you will finish liquidating your corporation and receive a final dividend on your stock holding.

Problem 1

Objective

Using figures, complete a *balance sheet.*

Preparing to Work

1. Help other students arrange the classroom for a *conference.* There should be enough seats for every class member.
2. The *board members* will lead the *stockholders* in balancing the accounting sheet. The *board members* should take turns reading each item while *stockholders* silently read with them.
3. Each item should be discussed, calculated, and entered on the *Balance Sheet.* See Fig. 87-1.

Balance Sheet

Cash (a)

4. Cash includes currency which is paper money, checks, bank drafts, and money orders. In the blank, list the total amount of all income from the sale of lamps. You found this amount in ACTIVITY 86, Fig. 86-3.

Accounts Receivable (b)

5. This figure is $0.00.

Materials (c)

6. All materials used for one lamp are assumed to come to $3.25. Multiply the cost of materials for one lamp by the number produced. Enter your answer on line (c).

Merchandise Inventory (d)

7. The merchandise inventory consists of all products on hand that are ready for sale. Look up this amount in ACTIVITY 86, Fig. 86-3.

Total Current Assets (e)

8. The *total current assets* is the figure obtained by adding all the figures under *"Current Assets."* Do this addition and enter your answer in the blank to the right.

Fixed Assets (f-k)

9. The figures for all the items under this heading total $0.00. *Fixed assets,* you learned, are all the permanent physical items used by the company such as buildings, equipment, land, etc.

Total Assets (l)

10. *Total assets* consists of the figure obtained by adding *total current assets* and *total fixed assets.* Since there were *no* fixed assets, you should simply copy the figure recorded under *"Total Current Assets"* (e).

Accounts Payable (m)

11. This is the *financial obligation owed* for all materials received to make the lamps which have not been paid for. Assume that this figure is the *same* as the value of material assets figured in line (c). Place this figure in line (m).

Salaries Payable (n)

12. This is the money owed to employees for the corporation for one week. It has not yet been paid. Use the same figure that you used for the break-even chart in ACTIVITY 80. Enter your answer in line (n).

10858

Fig. 87-1. Balance Sheet

__________ __________Corporation

__________ ______, 19___

	ASSETS					
Current Assets:						
Cash	(a)	$_____				
Accounts Receivable	(b)	$ 00.00				
Materials	(c)	$_____				
Merchandise Inventory	(d)	$_____				
TOTAL CURRENT ASSETS			(e)	$_____		
Fixed Assets:						
Buildings	(f)	$ 00.00				
Land	(g)	$ 00.00				
Delivery Equipment	(h)	$ 00.00				
Mfg. & Office Equipment	(i)	$ 00.00				
Manufacturing Tools	(j)	$ 00.00				
TOTAL FIXED ASSETS			(k)	$_____		
				Total Assets	(l)	$_____
	LIABILITIES					
Liabilities:						
Accounts Payable	(m)	$_____				
Salaries Payable	(n)	$_____				
Unearned Income	(o)	$ 00.00				
Overhead	(p)	$_____				
				Total Liabilities	(q)	$_____
CORPORATE WORTH					(r)	$_____

Unearned Income (o)

13. The unearned income is money *received* in *advance* for goods or services which have *not* been provided to date. For your corporation it is zero.

Overhead (p)

14. Overhead is the *sum* of all *fixed costs* accrued in the operation of a corporation. It includes such items as taxes, electricity, gas, heat, etc. This figure is $10.

56857

Total Liabilities (q)

15. The *total liabilities* can be found by adding all items listed under "Liabilities." *Do this addition now.*

Corporate Worth (r)

16. To find the *corporate worth* of a company, *subtract* the *total liabilities* (q), from the *total assets* (l), and place the figure in line (r). If the liabilities are *greater* than the assets, subtract the assets from the liabilities. The company would now be operating at a *loss.*
17. If there is a *surplus,* no loss, then in (r) this is the amount to be *distributed* to the *stockholders* upon liquidation.

Problem 2

Objective

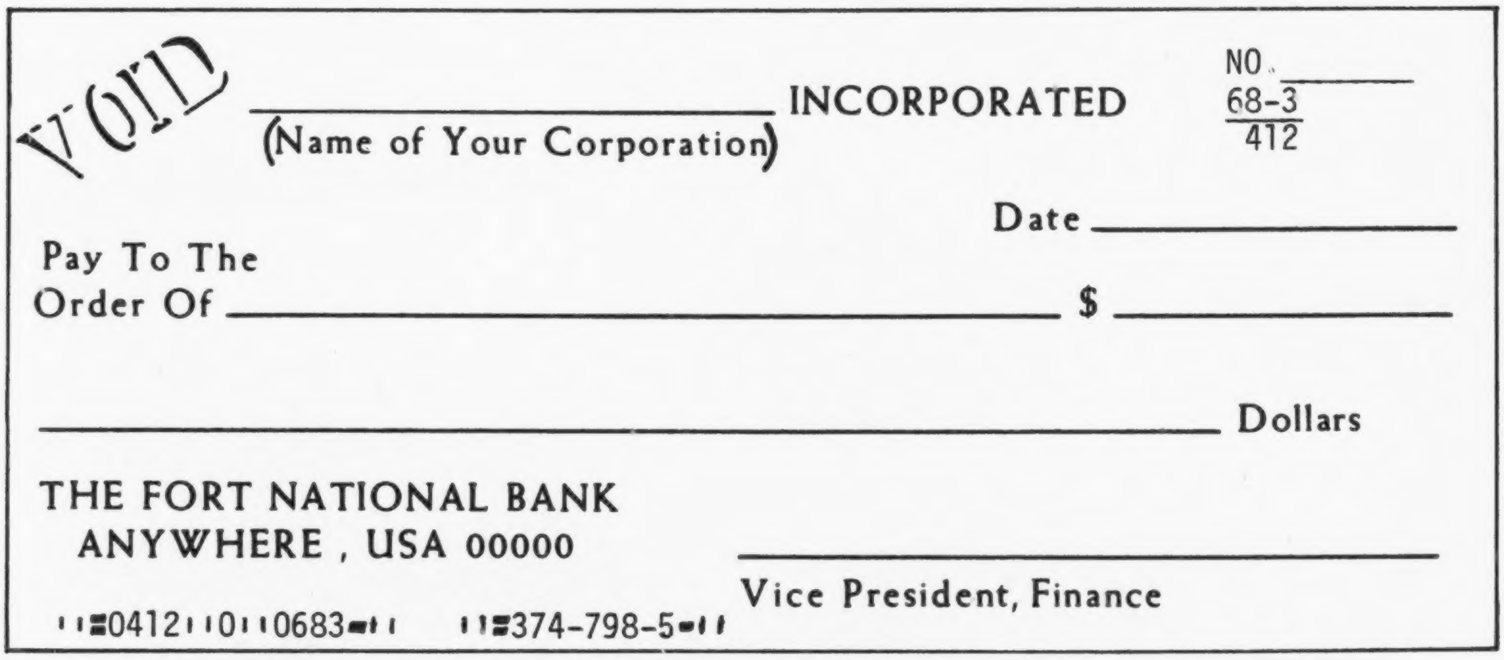
Using all necessary reports and data, legally dissolve or liquidate a corporation.

Calling Stockholders' Meeting

1. After the "books are balanced," the corporation *president* calls the stockholders' meeting to order.
    a. He states that the purpose of the meeting is to report the *current financial condition* of the corporation and take action on dissolving it.
    b. He asks the *vice-president of finance* to report on the financial condition, using the balance sheet. Is there a surplus or loss, etc.?
2. The financial condition of the corporation is then reported by the vice-president of finance.
3. The *president* recommends that the corporation be *dissolved.* He then calls for a vote from the *board of directors* to bring the matter before the stockholders.
4. Assuming an affirmative, a "yes," vote, the decision to dissolve the corporation is recommended to the stockholders by the *president.*

Liquidating

5. The *stockholders* decide to vote in favor of liquidating the corporation and going out of business.
6. As a class, calculate the *dividend* on each share of stock: *divide* the corporate worth by the total number of shares. Use the following formula:



VOID

____________________ INCORPORATED
(Name of Your Corporation)

NO. ________
68-3
412

Date ____________

Pay To The
Order Of ____________________ $ __________

____________________________ Dollars

THE FORT NATIONAL BANK
ANYWHERE , USA 00000

____
Vice President, Finance

⑆0412⑆0⑆0683⑈ ⑆374-798-5⑈

Fig. 87-2. Blank Check

$$\frac{\text{Total worth}}{\text{Total shares}} = \text{dividend per share}^*$$

*If there is a surplus, only.

7. Calculate the amount of money due each registered stockholder by *multiplying* the *amount* per share times the *number* of shares the stockholder has.
8. Prepare checks payable to each stockholder in the amount calculated, by making out *your own check,* Fig. 87-2. The vice-president of finance will *sign* each check.
9. Each *stockholder* will turn in his stock certificate, in exchange for the check with the finance vice-president's signature.
10. The corporation president will return the corporation's charter to the Secretary of State. Hand charter to the teacher.
11. The president adjourns or ends the meeting.
12. The *corporation* is now officially dissolved or liquidated.

ACTIVITY 88

Manufacturing in the Future

Today you will formulate ideas for products that might be manufactured in the future.

Problem 1

Objective

Using ideas that may have been gained from the filmstrip presentation, list five new products that might be manufactured in the future.

Supplies (Group of 5)
5 pcs. scrap paper 4¼″ x 5½″

Formulating Ideas for New Products

1. On a piece of scrap paper list five new products that you think might be manufactured in the future.
2. If time permits, draw a small sketch of each.
3. Volunteer to explain your ideas to the class.

Problem 2

Objective

Observing samples of products manufactured during the year and relying on your experience in making similar products, volunteer suggestions for improving the design of each product.

1. The recorder in your group should make a note of any suggestions made by your group, write the number of your group on the paper, and turn the list in to the teacher at the end of the period.

ACTIVITY 89

Story of Basic Machine Tools

Today's work concerns basic machine tool practices and their applications to manufacturing.

Problem

Objective

Using an illustrated presentation on machine tool practices:

a. Match illustrations of five basic machine tool practices with the names of the practices.
b. Name three practices not shown.
c. Identify three descriptions that apply to machine tools.

Questions

1. Match the five machine tool practices to their titles by placing a letter beside each title. See Fig. 89-1.

   __________ drilling and boring

   __________ turning

   __________ grinding

   __________ milling

   __________ planing and shaping

2. Three machine tool practices were not illustrated. They would be listed as "special." Name them. See Fig. 89-1.

   a. ______________________________

   b. ______________________________

   c. ______________________________

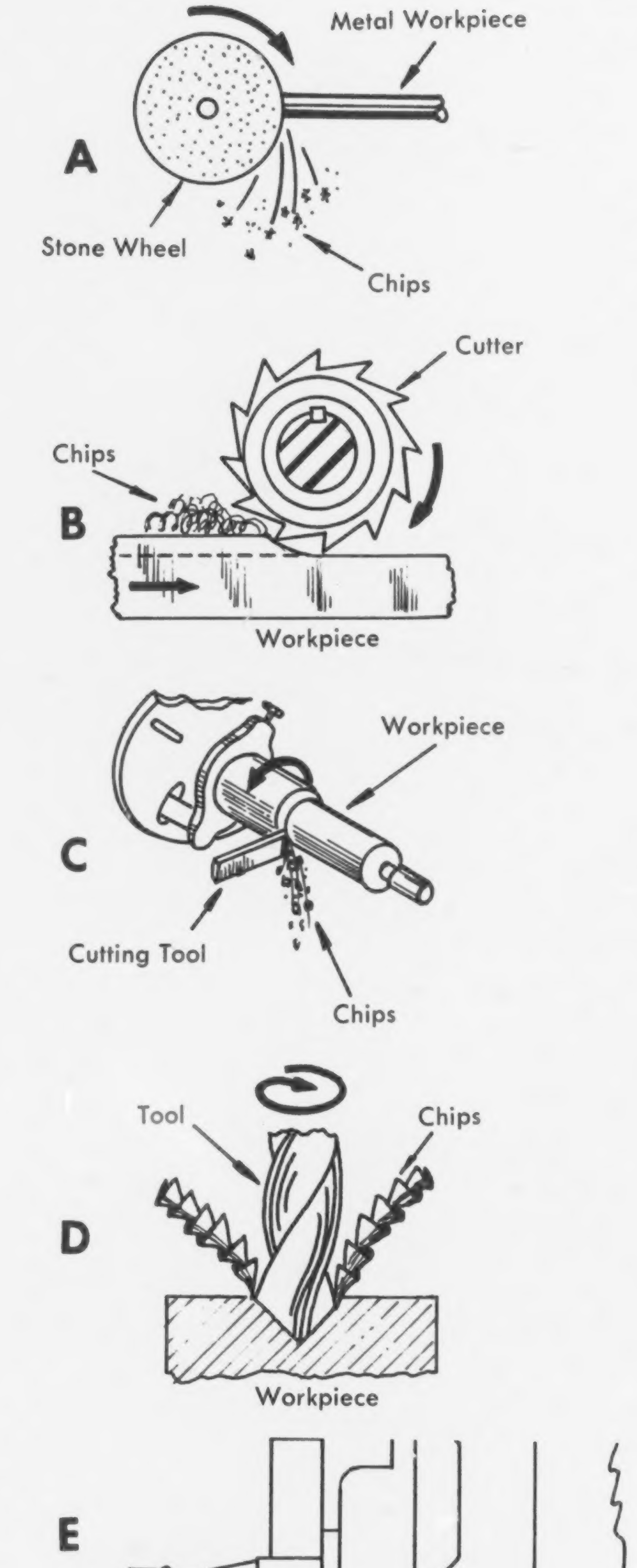

Metal Workpiece
A
Stone Wheel
Chips
Cutter
Chips
B
Workpiece
Workpiece
C
Cutting Tool
Chips
Tool
Chips
D
Workpiece
E
Cutting Tool
Chips
Workpiece

Fig. 89-1. Machine Tool Practices

3. Check (√) the three descriptions that *apply* to a machine tool. See Fig. 89-1.

_______ a. Not portable by hand.

_______ b. Portable by hand.

_______ c. Power-driven machine.

_______ d. Hand-driven machine.

_______ e. Used to shape or form material by cutting.

_______ f. Forming metal by heat.

ACTIVITY 90A

Story of Rubber Products

Problem

Objective

Using the filmstrip, "Story of Tires," answer some questions about a *reinforced* rubber product.

Questions

1. List several kinds of tests performed on tires.

   a. ____________________

   b. ____________________

   c. ____________________

2. Name the four major *parts* of a tire.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

3. The industrial process in which all the ingredients are mixed together is called

   ____________________.

4. What machine is used to carry out this mixing process for rubber?

   ____

5. Name four kinds of motor vehicles that need *tires*.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

6. Rubber tires are reinforced with fabric

   plies, mostly ____________________

   and ______________.

7. How big is the world's *largest tire*?

   a. It weighs__________ pounds.

   b. It is __________ feet high.

   c. It is __________ feet wide.

ACTIVITY 90B

Story of Rubber Products

Rubber can be *natural* or *synthetic*. Rubber products are made by *dipping, molding, reinforcing, stamping* or *cutting*, and by *foam* processes. Today you will use a dipping process to make balloons.

Problem

Objective

Using proper equipment and supplies, manufacture balloons: a *dipped* rubber product.

Equipment (Group of 5)

2	small test tubes
	and/or
2	25W or 40W light bulbs
	and/or
	Christmas tree bulbs for molds
1	5 qt. bucket, for warm water
1	heat lamp
1	watch or clock with a second-hand

Supplies (Group of 5)

10 oz.	coagulant, clear
10 oz.	liquid latex, blue
2	paper cups, approx. 12 oz. size
2 pcs.	6″ x 6″ plastic film *or* snap-on cup lids

Supplies (Class)

1 can	talcum powder

Preparing to Work

1. Obtain the necessary equipment. The various balloon molds should be at room temperature or warmer.
2. Your group's equipment supervisor is to pour 10 ounces of latex into one paper cup and 1 ounce of coagulant into the other paper cup.
3. Cover both cups with the lid or plastic film. This will prevent the latex from coagulating in the cup.

Applying the Coagulant

4. Insert a mold in *coagulant* for 10 seconds. See Fig. 90B-1.
5. *Withdraw* your mold from the coagulant and *cover* the coagulant cup. Rotate the mold in the air for about one-half to one minute. It will look clear as it dries. Do not touch it.

Applying the Latex

6. Uncover the cup of *latex*. "Skim" the top off the latex with a piece of paper. Throw only the paper in the trash.
7. Dip the mold into the latex *slowly*. Do not stop until it is submerged above the line left by the coagulant. See Fig. 90B-2.

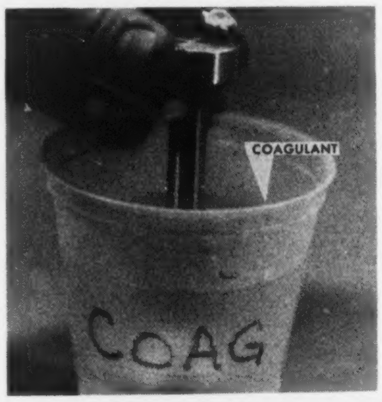


Fig. 90B-1. Dip Mold for 10 Seconds in Coagulant

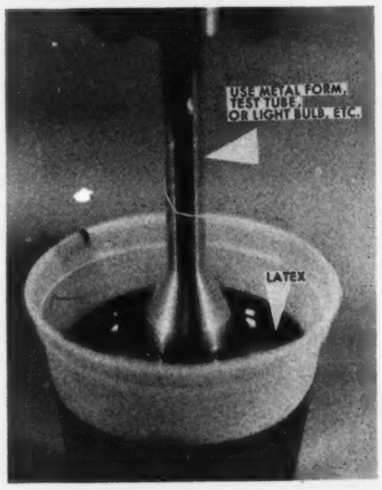


Fig. 90B-2. Dip Mold for 10 Seconds in Latex

8. Hold the mold in the latex for *60* seconds. Then *slowly* and *steadily* withdraw it.
9. *Cover* the *latex* cup with a lid or plastic film.
10. Rotate the mold so that drops will not form and run together.

Rolling Edges

11. When the latex is *no longer sticky* to the touch, *roll* the latex film down to form a *rolled edge* on the balloon. See Fig. 90B-3.

Washing the Dipped Balloon

12. Move the balloon and mold around a bucket of fairly warm water for about 5 minutes to cure it.

Curing and Removing the Balloon

13. Rotate the balloon and mold under the heat lamp to cure it more. If available, heat from a soldering furnace, forging furnace, or torch will work equally well. If used, wear goggles. Be careful not to burn yourself.
14. Let the balloon *cure* for 10-15 minutes.
15. Sprinkle the balloon with *talcum powder*. It should then be ready to remove from the mold. See Figs. 90B-4 and 5.
16. "Roll" the balloon off the mold.
17. You should be able to blow up the balloon to a diameter of about six inches. This *test* completes the product.

Cleaning Up

18. Clean up the work area and return all equipment and supplies.
19. Answer the questions below.

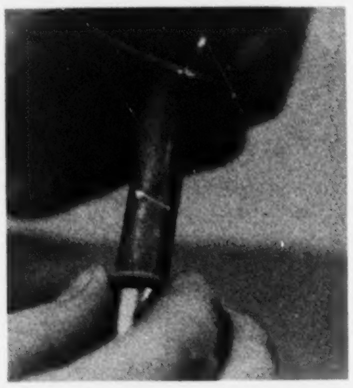


Fig. 90B-3. Rolling the End

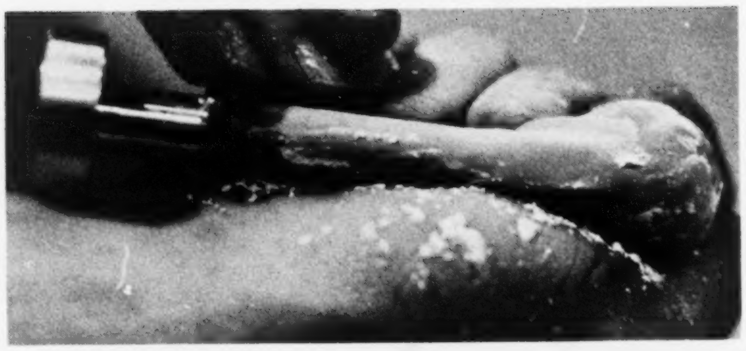


Fig. 90B-4. Coat Balloon with Talc

Fig. 90B-5. Finished Balloon

Questions

1. Why are balloons called *dipped* rubber products?

   ____

   ____

2. Name some other dipped rubber products.

   a. ______________

   b. ______________

3. Dipped rubber products are made from liquid______________.
4. What would you need to make larger balloons?

   ____

5. What is synthetic material?

   ____

   ____

ACTIVITY 91A

Story of the Telephone

Problem 1

Objective

Using information from the filmstrip, "The One Big Machine," show how to hook up an old fashioned telephone system and a modern telephone system and observe the difference.

Connecting Telephone Stations

1. Figure 91A-1 shows a diagram of modern and old fashioned telephone system hookups. Study and compare the hookups. See Fig. 91A-1.

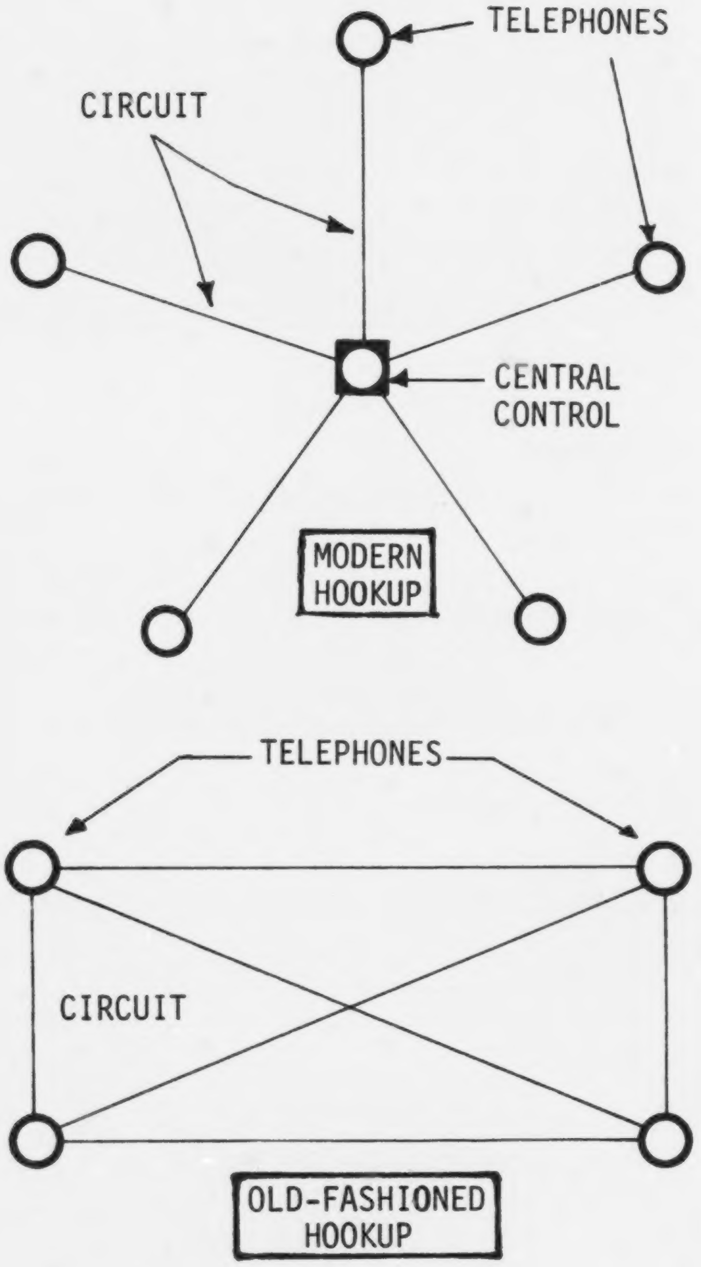

TELEPHONES
CIRCUIT
CENTRAL CONTROL
MODERN HOOKUP
TELEPHONES
CIRCUIT
OLD-FASHIONED HOOKUP

Fig. 91A-1. New and Old Circuitry

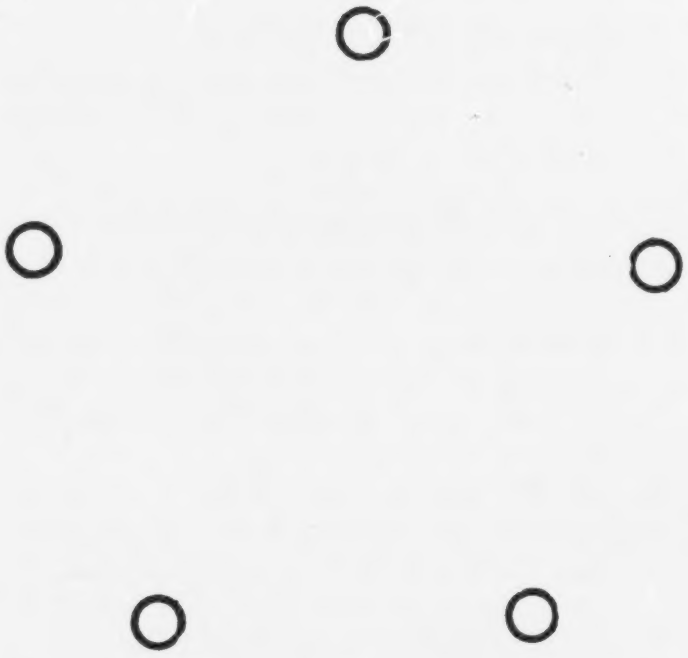


Fig. 91A-2. Connect All Five Telephones to Each Other by Old Fashioned Hookup

Fig. 91A-3. Connect All Six Telephones to Each Other by Old Fashioned Hookup

Fig. 91A-4. Separating and Counting Wires

2. Connect the stations in using the old fashioned system. See Figs. 91A-2 and 91A-3.
3. Record the number of connecting circuits you needed:

   For Fig. 91A-2, ______ circuits

   For Fig. 91A-3, ______ circuits
4. If these were modern systems, how many connecting circuits would be needed?

   For Fig. 91A-2, ______ circuits

   For Fig. 91A-3, ______ circuits

Problem 2

Objective

Using a telephone multi-wire cable, harness, count the wires it contains and determine how many color combinations are used on the various wires.

Equipment (Group of 5)

2 pcs. telephone multi-wire cable, harness,
approx. 2′ length

Examining the Harness

1. Meet with your regular group of five.
2. Each pair of students will work with one harness. The *foreman* will divide his group and assist in the activity.
3. As you count the wires, separate the wires counted from the ones remaining to be counted. One boy will count and the other will hold the wires already counted. See Fig. 91A-4.
4. Record the number of wires counted

   here: ______
5. If time permits, list the various color combinations you see. You may use a blank page in your Laboratory Manual.

Cleaning Up

6. Clean the area and return all equipment.

Questions

1. Using the old fashioned hookup, when there are four telephones how many circuits are needed?

   ______ wires.
2. When the fifth telephone is added, how many additional circuits are needed?

   ______ additional circuits.
3. What would happen if one more telephone had to be added?

   ______

   ______
4. With five telephones, how many circuits are *eliminated* by using central control?

   ______ circuits.
5. What happens in central control when one telephone wants to be connected to any other telephone or to several telephones?

   ______

   ______

   ______

NOTE: When *more than two* telephones are connected at the same time, the phone call is known as a "conference call."

6. How many different color combinations did you find on the wires in the harness?

   ______

ACTIVITY 91B

Story of the Telephone

Today you will examine a phone and its components. It may be a push-button or dial phone.

Problem

Objective

Using a telephone subassembly, identify some of the processes and materials involved in its manufacture.

Equipment (Class)

Disassembled telephone parts:

1	handset
1	push-button *or* dial assembly
1	body shell
1	ringer
1	circuit package, base plate
1	package-container

General Instructions

1. Each group of students will receive one of the *six* disassembled displays of the telephone.
2. As a group, *discuss* how a particular component was manufactured. Some components are combined into sub assemblies. See Fig. 91B-1.
3. Identify your group of components and *turn* to the proper component name in the Laboratory Manual.
4. List as many of the materials as you can that make up the components on your board. Record them at the end of your group's problem.
5. Answer questions about your assignment at the end of today's laboratory activity.

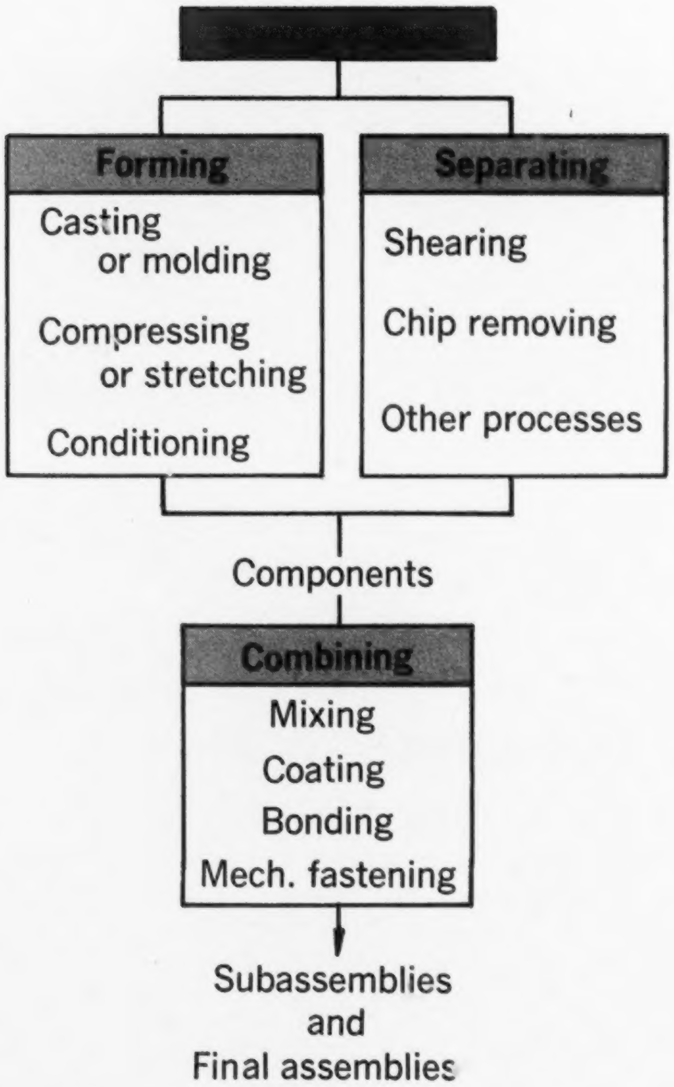

Forming
Casting or molding
Compressing or stretching
Conditioning
Separating
Shearing
Chip removing
Other processes
Components
Combining
Mixing
Coating
Bonding
Mech. fastening
Subassemblies and Final assemblies

Fig. 91B-1. Production Processes

Group 1
Handset

1. Your group has received the telephone *handset*. Notice how it looked as an assembled unit. See Fig. 91B-2.
2. Locate the handset *mouthpiece cap*. See Fig. 91B-3.
3. Discuss within your group the processes involved in making the mouthpiece cap.
4. Select a group spokesman who will explain to the rest of the class how the *mouthpiece* was manufactured.
5. List as many different materials as you can which have been used to make up the components.

Group 2
Push-Button Assembly

1. Your group has received the telephone

push-button or dial assembly. Locate the *mechanical section* and the *electronic section.* See Fig. 91B-4.

2. Locate the *square dial plate.* Discuss with your group the process involved in manufacturing it.
3. Locate the *mechanical parts* and discuss with your group the process involved in making them. See Fig. 91B-5.
4. Discuss with your group the processes used in making the *electronic section.*
5. Select a group spokesman who will explain to the rest of the class how the *push-button or dial assembly* was manufactured.
6. List as many different materials as you can which have been used to make up the components on your board.

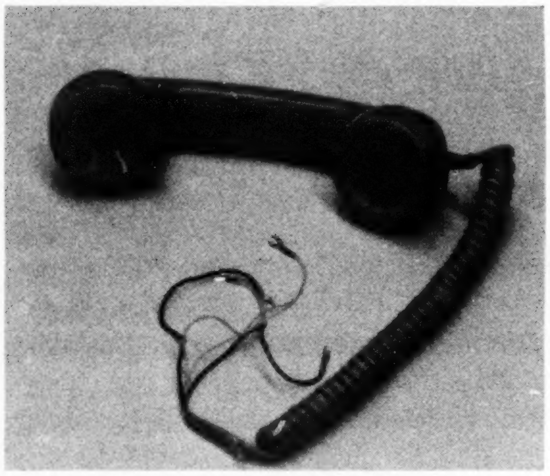


Fig. 91B-2. Assembled Handset

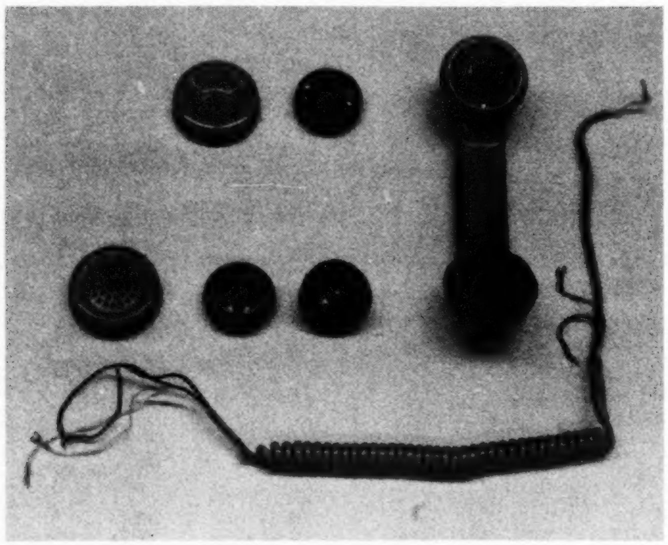


Fig. 91B-3. Handset Parts

Group 3
Body Shell

1. Your group has received the telephone *body shell.* Notice how it looked as an assembled unit. See Fig. 91B-6.

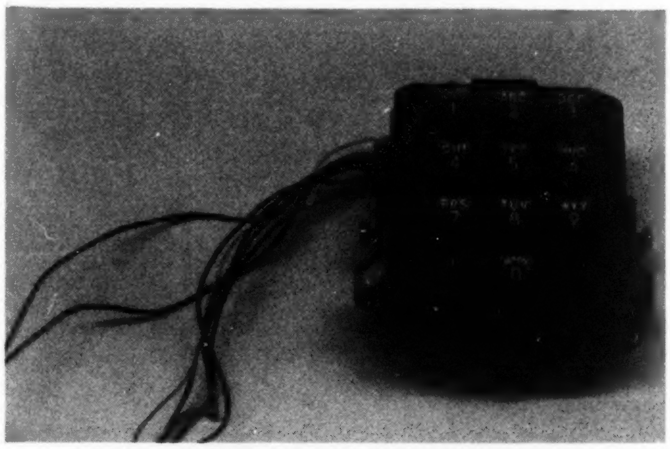


Fig. 91B-4. Dial Assembly

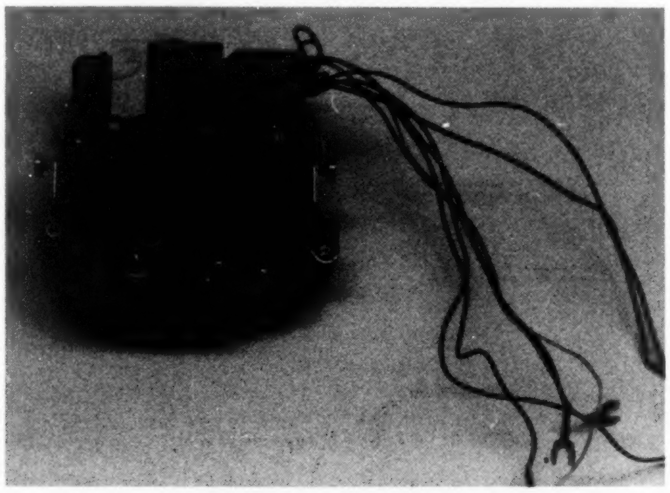


Fig. 91B-5. Mechanical and Electronic Parts

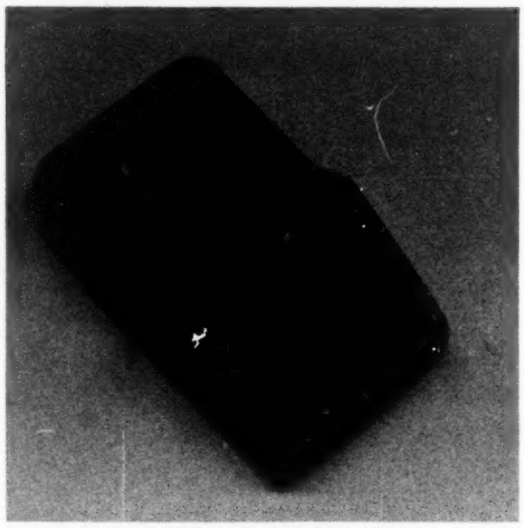


Fig. 91B-6. Body Shell Assembly

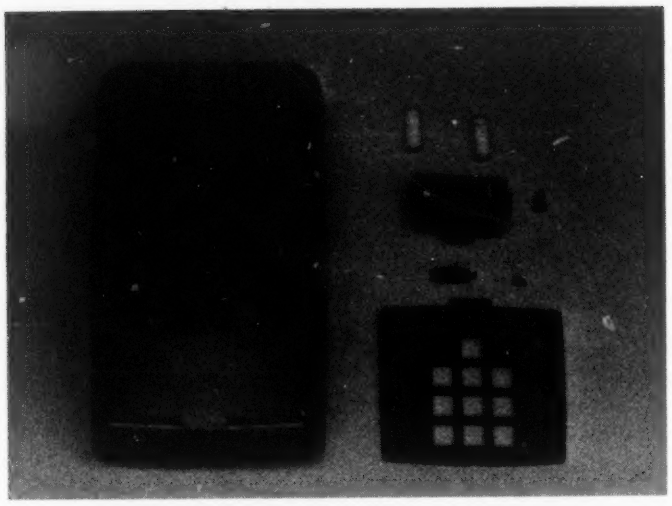


Fig. 91B-7. Shell Parts

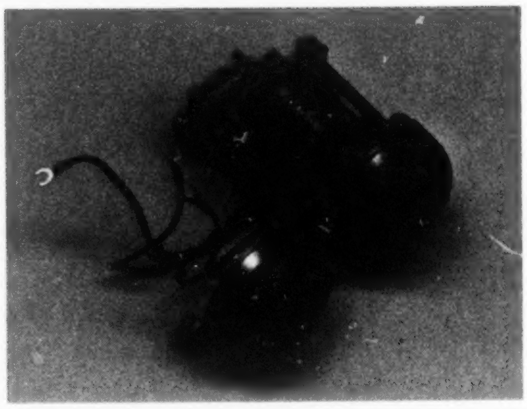


Fig. 91B-8. Ringer Assembly

2. Look at the *body shell.* See Figs. 91B-6 and 91B-7.
3. Discuss within your group the processes involved in making the *body shell.*
4. Select a group spokesman who will explain to the rest of the class how the *shell* was manufactured.
5. List as many different materials as you can which have been used to make the components on your board.

Group 4
Ringer

1. Your group has received the telephone *ringer.* Notice how it looked as an assembled unit. See Fig. 91B-8.
2. Locate the *brass bells.* See Fig. 91B-9.
3. Discuss within your group the processes involved in making the bells.
4. Select a group spokesman who will explain to the rest of the class how the *bells* were manufactured.
5. List as many different materials as you can which have been used to make the component on your board.

Group 5
Circuit Package, Base Plate, and Switch

1. Your group has received the telephone *circuit package, base plate,* and *switch.* This is a group of three subassemblies, but the pop rivets prevent further disassembly. Fig. 91B-10 shows an assembled switch unit.
2. Locate the *base plate.* See Fig. 91B-10.
3. Discuss within your group the processes involved in making the *base plate.*
4. Select a group spokesman who will explain to the rest of the class how the *plate* was manufactured.
5. List as many different materials as you can which have been used to make the components on your board.

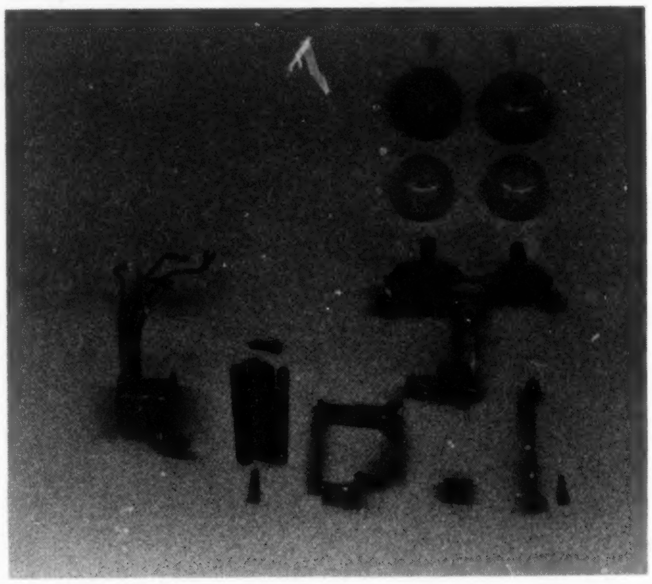


Fig. 91B-9. Ringer Parts

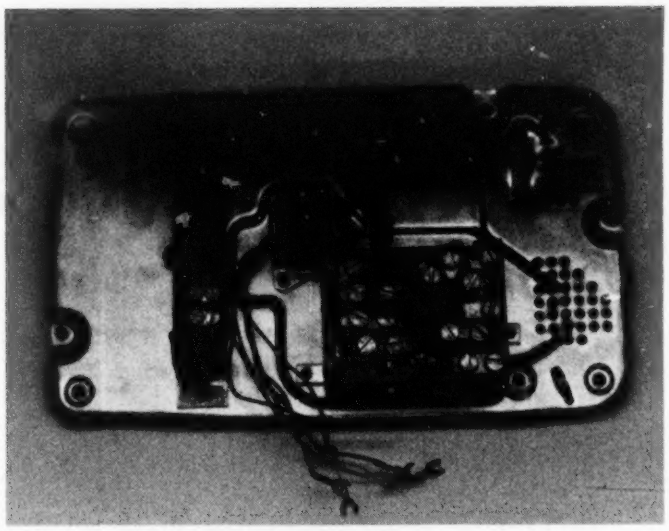


Fig. 91B-10. Circuit, Plate, and Switch Assembly

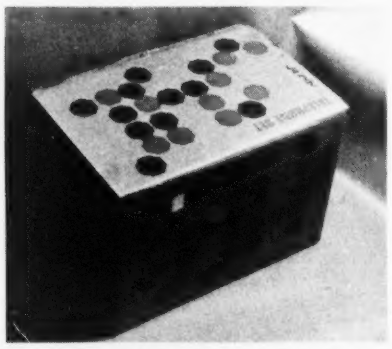


Fig. 91B-11. Package Assembly

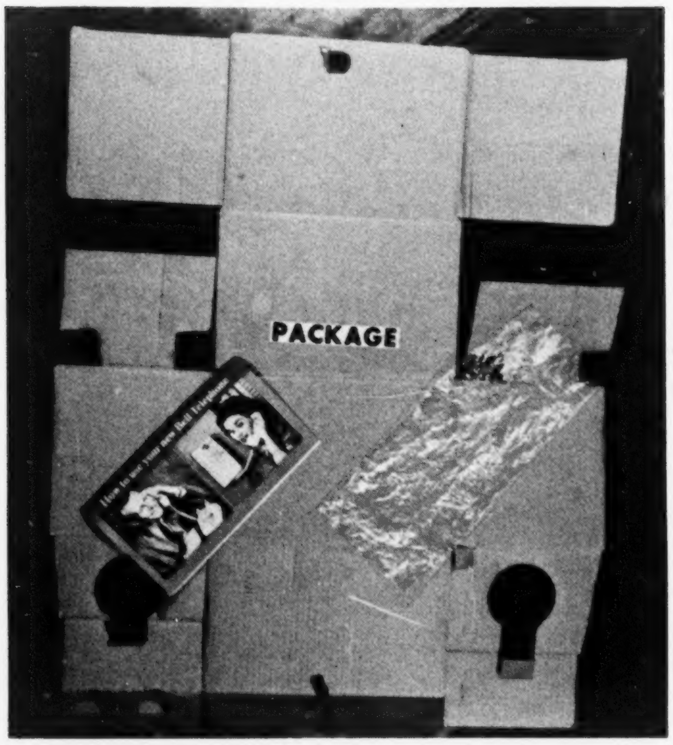


Fig. 91B-12. Package Flat

Group 6
Package

1. Your group has received the telephone *package*. Figure 91B-11 shows the package containing the telephone.
2. Lay the package out *flat*. See Fig. 91B-12.
3. Discuss within your group the processes involved in manufacturing the *packages* for the telephone.
4. Select a group spokesman who will explain to the rest of the class how the *package* was manufactured.
5. List as many different materials as you can which have been used to make the *package* components.

Questions

Where choices are provided, circle the correct answer. *Fill in* the empty blanks.

1. Your group's assignment was the

   ____________________________________.
2. Is it a component or subassembly? If your answer is *component*, go to Question 3. If your answer is *subassembly*, go to Question 4.
3. Was the component made by forming or separating? If your answer is *forming*, go to Question 5. If your answer is *separating*, go to Question 6.
4. Was the subassembly combined by mixing, coating, bonding, or mechanical fastening? Go to Question 7.
5. Was the component formed by casting-molding, compressing-stretching, and/or conditioning? Stop.
6. Was the component separated by shearing, chip removing, or other processes? Stop.
7. How many parts are in the subassembly? ________ Go to Question 8.
8. Choose one part: ______________________

   Follow this part through manufacture by answering Question 3 *and* either Questions 5 *or* 6.